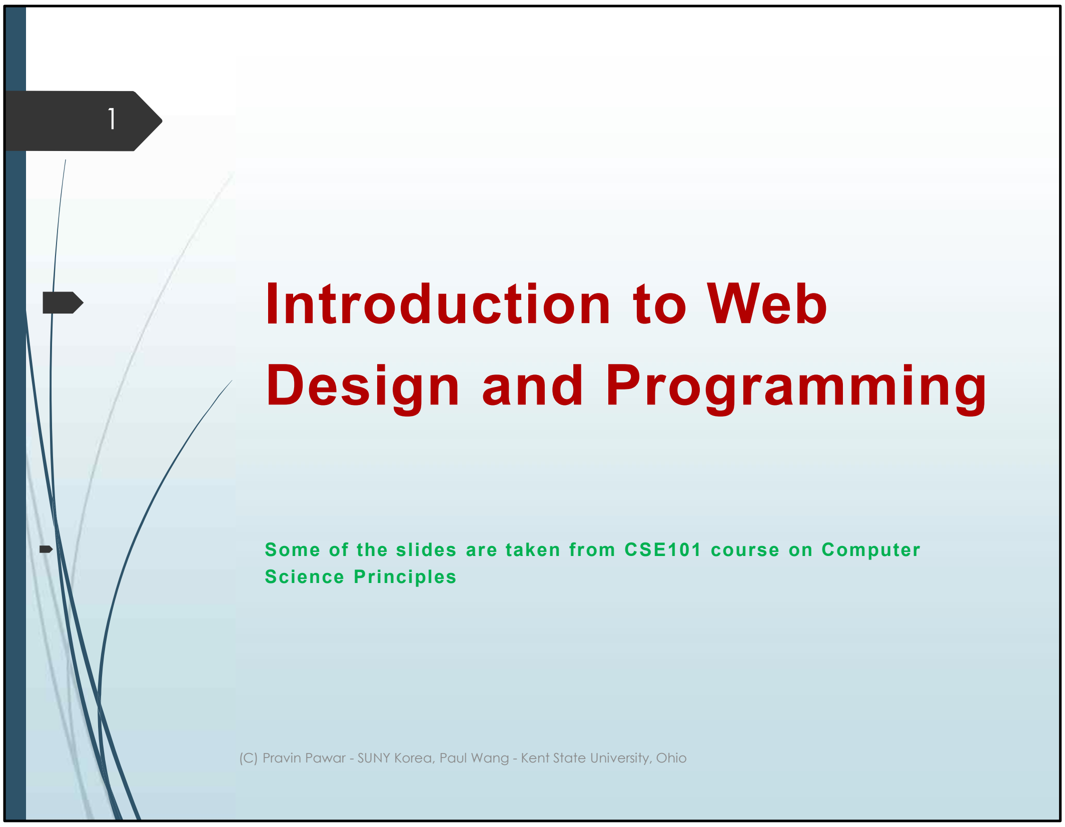
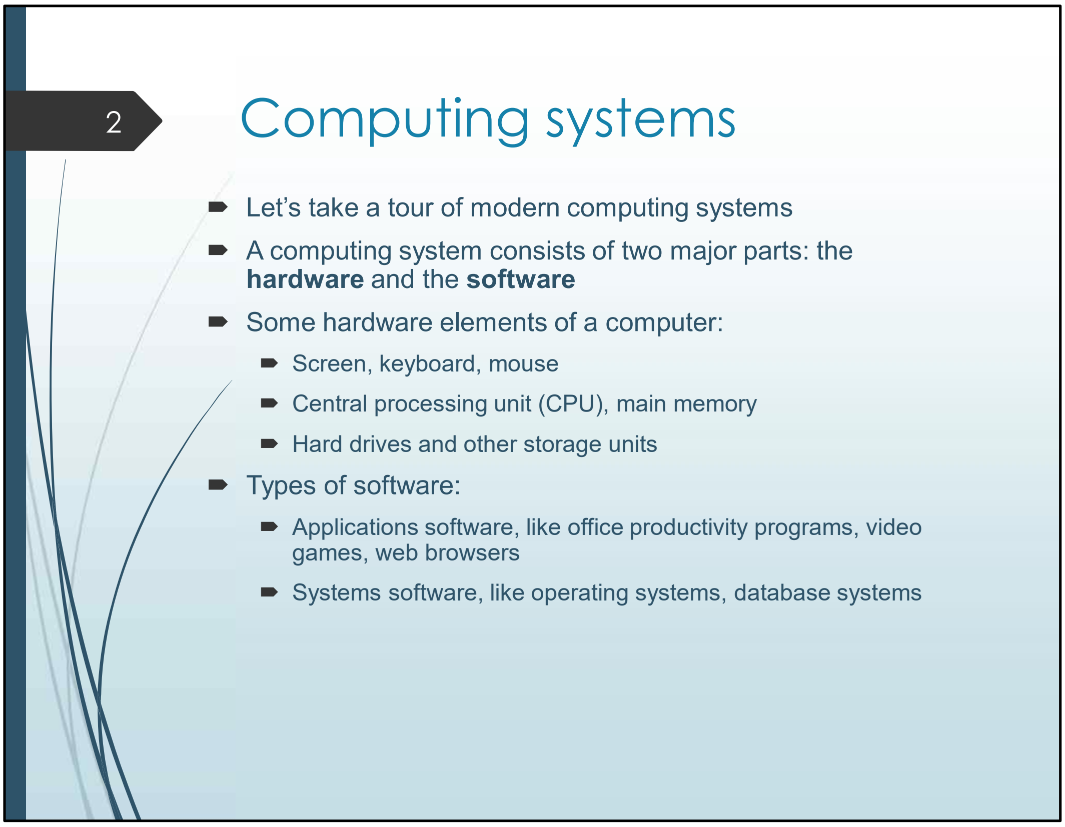


1

Introduction to Web Design and Programming

Some of the slides are taken from CSE101 course on Computer Science Principles

1



2

Computing systems

- Let’s take a tour of modern computing systems
- A computing system consists of two major parts: the **hardware** and the **software**
- Some hardware elements of a computer:
  - Screen, keyboard, mouse
  - Central processing unit (CPU), main memory
  - Hard drives and other storage units
- Types of software:
  - Applications software, like office productivity programs, video games, web browsers
  - Systems software, like operating systems, database systems

2

3

Computing systems

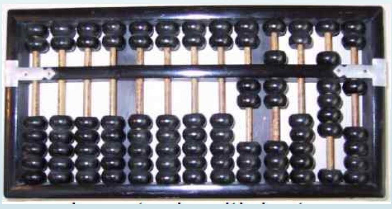
- Can hardware exist without software?
  - Sure, but is it useful? ➔ It depends
    - General Purpose CPUs [Intel x86, core i5, i7, etc.] Not really
    - Specialized hardware [FPGAs, ASICs with functionality built into hardware] – Yes. Although functionality was developed with software based tools
- Can software exist without hardware?
  - In a literal sense, no – hardware is needed to execute software
  - But, the underlying problem-solving techniques employed by the programmer to create the software do exist separately from the hardware and software
- One more part to a computer system: data
  - The software needs some kind of data to process: numbers, text, images, sound, video

3

4

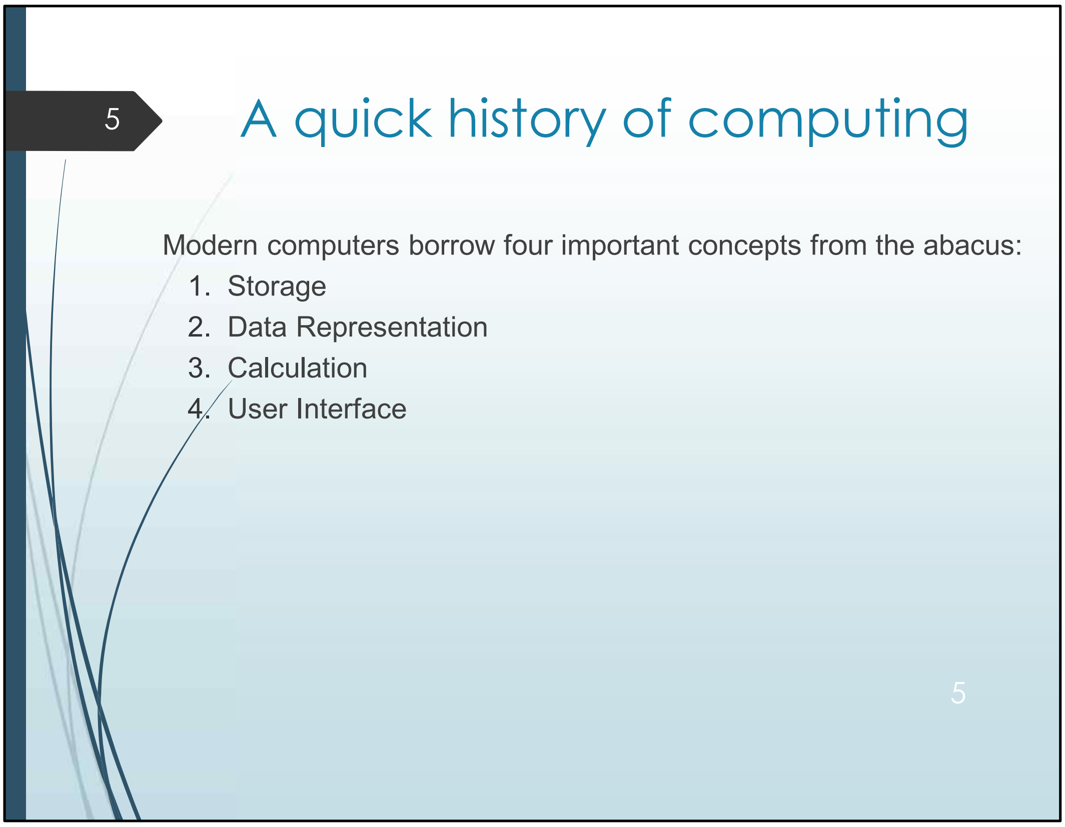
A quick history of computing

- We think of computers as modern inventions
- Computing devices
  - go back thousands of years
  - have many of the same basic features of digital computers
- **Abacus** – an early device to record numeric values and do basic arithmetic (16th century B.C.)



- https://www.youtube.com/watch?v=GF6nCmcQ5es
- What does an abacus have to do with laptops, smartphones and tablet computers???

4



5

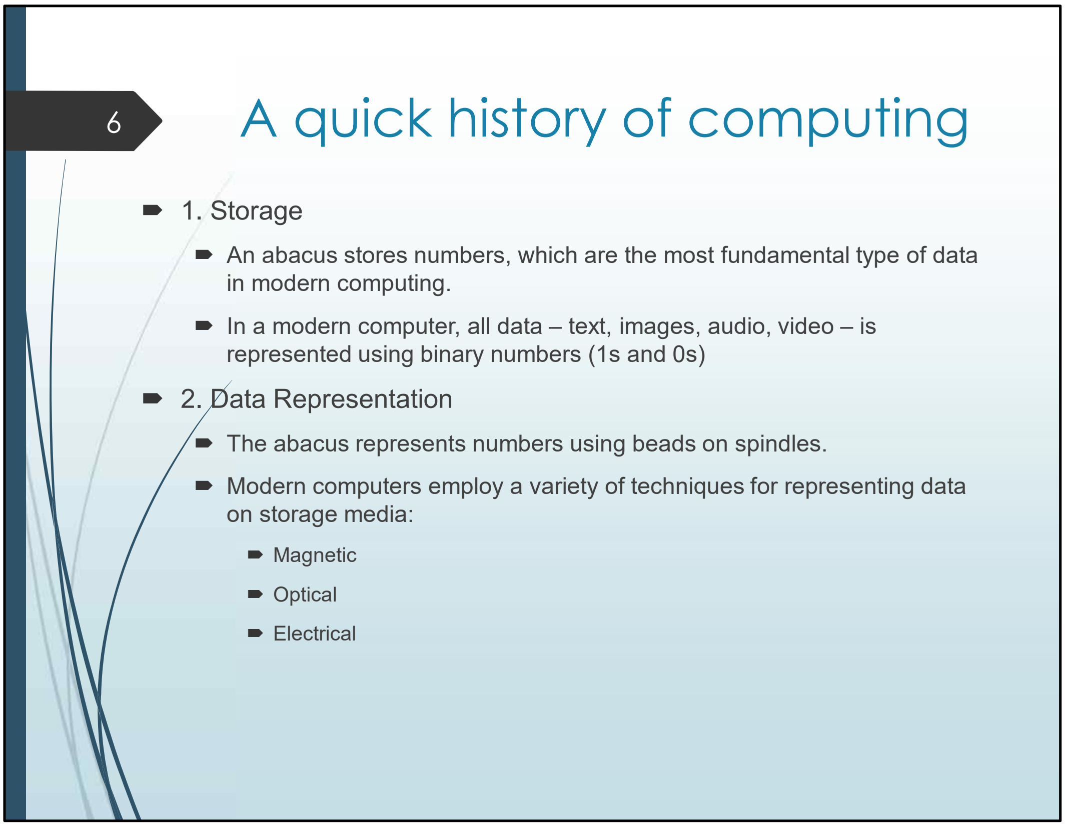
A quick history of computing

Modern computers borrow four important concepts from the abacus:

1. Storage
2. Data Representation
3. Calculation
4. User Interface

5

5

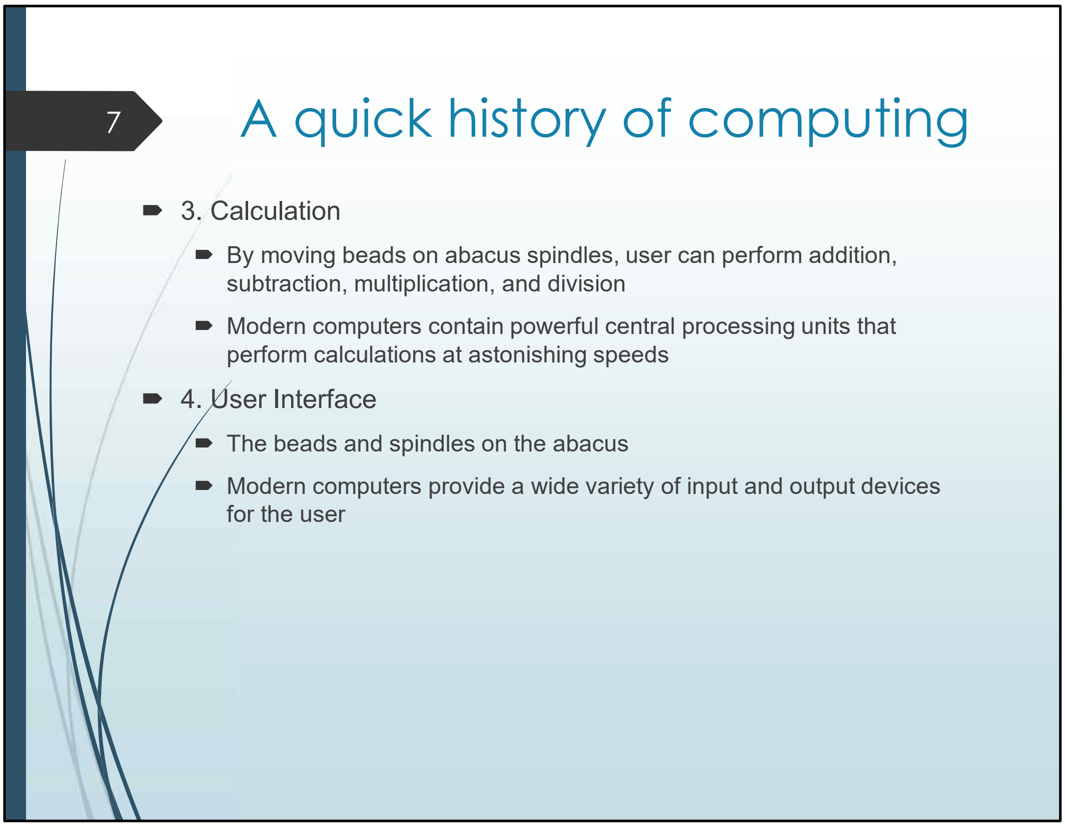


6

A quick history of computing

- 1. Storage
  - An abacus stores numbers, which are the most fundamental type of data in modern computing.
  - In a modern computer, all data – text, images, audio, video – is represented using binary numbers (1s and 0s)
- 2. Data Representation
  - The abacus represents numbers using beads on spindles.
  - Modern computers employ a variety of techniques for representing data on storage media:
    - Magnetic
    - Optical
    - Electrical

6

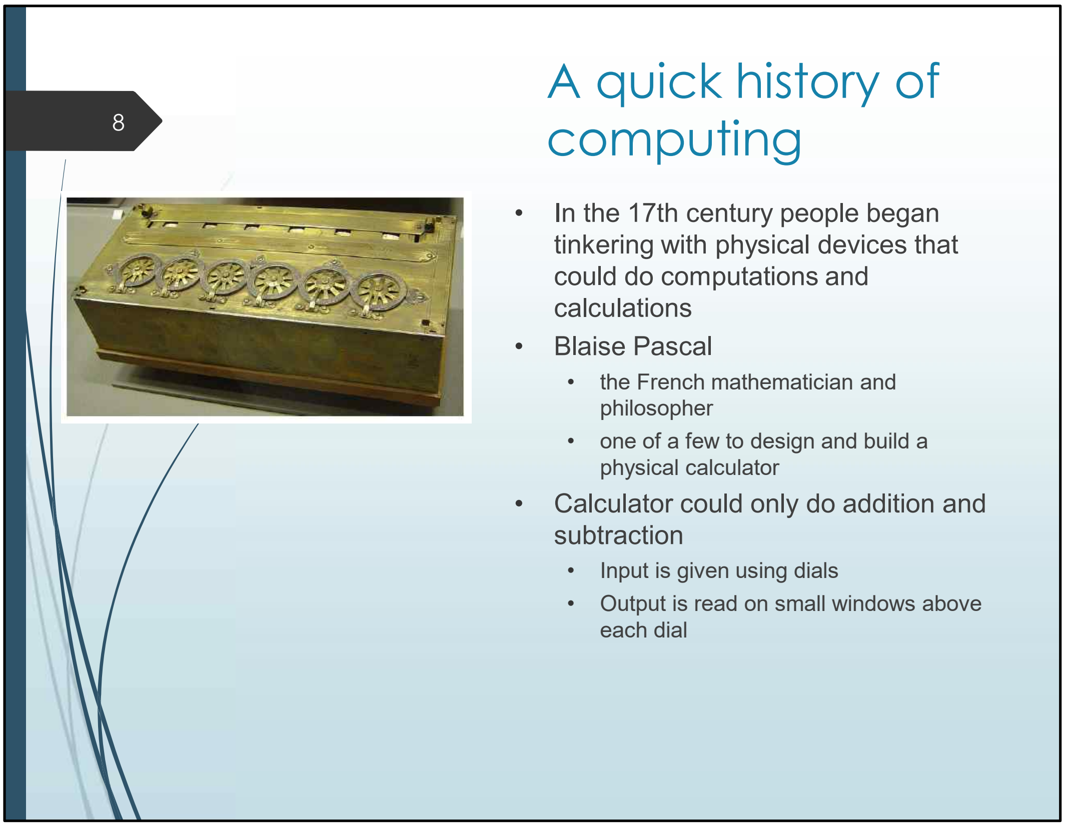


7

A quick history of computing

- 3. Calculation
  - By moving beads on abacus spindles, user can perform addition, subtraction, multiplication, and division
  - Modern computers contain powerful central processing units that perform calculations at astonishing speeds
- 4. User Interface
  - The beads and spindles on the abacus
  - Modern computers provide a wide variety of input and output devices for the user

7



8

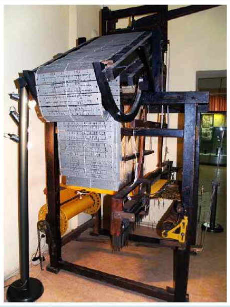
A quick history of computing

- In the 17th century people began tinkering with physical devices that could do computations and calculations
- Blaise Pascal
  - the French mathematician and philosopher
  - one of a few to design and build a physical calculator
- Calculator could only do addition and subtraction
  - Input is given using dials
  - Output is read on small windows above each dial

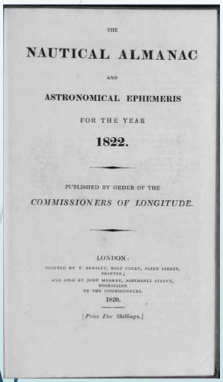
8

Programmable devices

- Pascal’s calculator and other similar devices of that time were not programmable
- One of the first programmable devices in history was a loom
- Joseph Marie Jacquard’s loom (1804) could be programmed by feeding in a set of punched cards
- This is not all that different from quitting a program that’s running on your computer and starting another one!
- https://www.youtube.com/watch?v=MQzpLLhN0fY



Rise of Analytical Engine



THE

NAUTICAL ALMANAC

AND

ASTRONOMICAL EPHEMERIS

FOR THE YEAR

1822.

PUBLISHED BY ORDER OF THE

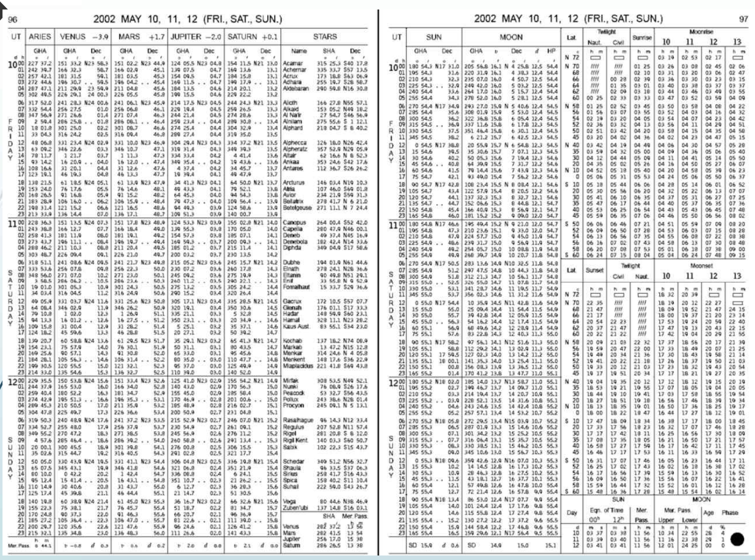
COMMISSIONERS OF LONGITUDE.

LONDON:
PRINTED BY T. BENSLEY, BOLT COURT, FLEET STREET,
PRINTER;
AND SOLD BY JOHN MURRAY, ALBEMARLE STREET,
BOOKSELLER
TO THE COMMISSIONERS.
1820.

[Price Five Shillings.]

- Summer of 1821 – Mathematician Charles Babbage and astronomer John Herschel were working on creating a book of mathematical tables.
- Almanac contains tables denoting positions of the Moons, planets and stars – which are used by navigators to determine location at the sea.
- Manual work caused a number of errors.
- Babbage showed his frustration with the large number of errors by exclaiming, “I wish to God these calculations had been executed by steam!”
- What made Babbage think steam engines could help him solve mathematical problems?

11



96 2002 MAY 10, 11, 12 (FRI., SAT., SUN.)

	UT	ARIES	VENUS −3.9		MARS +1.7		JUPITER −2.0		SATURN +0.1		STARS		
	d h	GHA	GHA	Dec	GHA	Dec	GHA	Dec	GHA	Dec	Name	SHA	Dec
	10 00	227 37.2	151 33.2	N23 58.3	151 02.2	N23 44.9	124 05.5	N23 04.8	154 11.5	N21 13.0	Acamar	315 25.3	S40 17.8
	01	242 39.7	166 32.3	58.7	166 02.9	45.1	139 07.5	04.7	169 13.6	13.1	Achernar	335 33.7	S57 13.5
	02	257 42.1	181 31.5	59.1	181 03.5	45.3	154 09.5	04.7	184 15.8	13.1	Acrux	173 18.8	S63 06.9
	03	272 44.6	196 30.7	. . 59.5	196 04.2	. . 45.4	169 11.5	. . 04.7	199 17.9	. . 13.1	Adhara	255 19.7	S28 58.7
	04	287 47.1	211 29.9	23 59.9	211 04.8	45.6	184 13.5	04.6	214 20.1	13.2	Aldebaran	290 59.8	N16 30.8
	05	302 49.5	226 29.1	24 00.3	226 05.5	45.8	199 15.5	04.6	229 22.2	13.2			
	06	317 52.0	241 28.3	N24 00.6	241 06.1	N23 45.9	214 17.5	N23 04.5	244 24.3	N21 13.3	Alioth	166 27.8	N55 57.1
	07	332 54.4	256 27.5	01.0	256 06.8	46.1	229 19.4	04.5	259 26.5	13.3	Alkaid	153 05.2	N49 18.2
	08	347 56.9	271 26.6	01.4	271 07.4	46.3	244 21.4	04.5	274 28.6	13.3	Al Na'ir	27 54.7	S46 56.9
F	09	2 59.4	286 25.8	. . 01.8	286 08.1	. . 46.4	259 23.4	. . 04.4	289 30.8	. . 13.4	Alnilam	275 55.6	S 1 12.1
R	10	18 01.8	301 25.0	02.2	301 08.7	46.6	274 25.4	04.4	304 32.9	13.4	Alphard	218 04.7	S 8 40.2
I	11	33 04.3	316 24.2	02.5	316 09.4	46.8	289 27.4	04.4	319 35.0	13.5			
D	12	48 06.8	331 23.4	N24 02.9	331 10.0	N23 46.9	304 29.4	N23 04.3	334 37.2	N21 13.5	Alphecca	126 18.0	N26 42.4
A	13	63 09.2	346 22.6	03.3	346 10.7	47.1	319 31.4	04.3	349 39.3	13.5	Alpheratz	357 52.9	N29 05.9
Y	14	78 11.7	1 21.7	03.7	1 11.3	47.3	334 33.4	04.2	4 41.4	13.6	Altair	62 16.6	N 8 52.3
	15	93 14.2	16 20.9	. . 04.0	16 12.0	. . 47.4	349 35.4	. . 04.2	19 43.6	. . 13.6	Ankaa	353 24.6	S42 17.6
	16	108 16.6	31 20.1	04.4	31 12.6	47.6	4 37.4	04.2	34 45.7	13.7	Antares	112 36.7	S26 26.2
	17	123 19.1	46 19.3	04.8	46 13.3	47.7	19 39.4	04.1	49 47.9	13.7			
	18	138 21.5	61 18.5	N24 05.1	61 13.9	N23 47.9	34 41.3	N23 04.1	64 50.0	N21 13.7	Arcturus	146 03.4	N19 10.3
	19	153 24.0	76 17.6	05.5	76 14.6	48.1	49 43.3	04.1	79 52.1	13.8	Atria	107 46.0	S69 01.8
	20	168 26.5	91 16.8	05.9	91 15.2	48.2	64 45.3	04.0	94 54.3	13.8	Avior	234 21.9	S59 31.3
	21	183 28.9	106 16.0	. . 06.2	106 15.9	. . 48.4	79 47.3	. . 04.0	109 56.4	. . 13.9	Bellatrix	278 41.7	N 6 21.0
	22	198 31.4	121 15.2	06.6	121 16.5	48.6	94 49.3	03.9	124 58.6	13.9	Betelgeuse	271 11.1	N 7 24.4
	23	213 33.9	136 14.4	07.0	136 17.1	48.7	109 51.3	03.9	140 00.7	13.9			
	11 00	228 36.3	151 13.5	N24 07.3	151 17.8	N23 48.9	124 53.3	N23 03.9	155 02.8	N21 14.0	Canopus	264 00.4	S52 42.0
	01	243 38.8	166 12.7	07.7	166 18.4	49.0	139 55.3	03.8	170 05.0	14.0	Capella	280 47.9	N46 00.1
	02	258 41.3	181 11.9	08.0	181 19.1	49.2	154 57.3	03.8	185 07.1	14.1	Deneb	49 37.4	N45 16.9
	03	273 43.7	196 11.1	. . 08.4	196 19.7	. . 49.4	169 59.3	. . 03.7	200 09.3	. . 14.1	Denebola	182 42.4	N14 33.6
	04	288 46.2	211 10.3	08.8	211 20.4	49.5	185 01.2	03.7	215 11.4	14.1	Diphda	349 04.9	S17 58.6
	05	303 48.7	226 09.4	09.1	226 21.0	49.7	200 03.2	03.7	230 13.5	14.2			
	06	318 51.1	241 08.6	N24 09.5	241 21.7	N23 49.8	215 05.2	N23 03.6	245 15.7	N21 14.2	Dubhe	194 01.9	N61 44.6
	07	333 53.6	256 07.8	09.8	256 22.3	50.0	230 07.2	03.6	260 17.8	14.3	Elnath	278 24.1	N28 36.6
S	08	348 56.0	271 07.0	10.2	271 23.0	50.1	245 09.2	03.6	275 19.9	14.3	Eltanin	90 49.8	N51 29.1
A	09	3 58.5	286 06.2	. . 10.5	286 23.6	. . 50.3	260 11.2	. . 03.5	290 22.1	. . 14.3	Enif	33 55.8	N 9 52.9
T	10	19 01.0	301 05.3	10.9	301 24.3	50.5	275 13.2	03.5	305 24.2	14.4	Fomalhaut	15 33.7	S29 36.6
U	11	34 03.4	316 04.5	11.2	316 24.9	50.6	290 15.2	03.4	320 26.4	14.4			
R	12	49 05.9	331 03.7	N24 11.6	331 25.6	N23 50.8	305 17.1	N23 03.4	335 28.5	N21 14.5	Gacrux	172 10.5	S57 07.7
D	13	64 08.4	346 02.9	11.9	346 26.2	50.9	320 19.1	03.4	350 30.6	14.5	Gienah	176 01.1	S17 33.3
A	14	79 10.8	1 02.0	12.3	1 26.9	51.1	335 21.1	03.3	5 32.8	14.5	Hadar	148 59.9	S60 23.1
Y	15	94 13.3	16 01.2	. . 12.6	16 27.5	. . 51.2	350 23.1	. . 03.3	20 34.9	. . 14.6	Hamal	328 11.1	N23 28.2
	16	109 15.8	31 00.4	12.9	31 28.2	51.4	5 25.1	03.2	35 37.1	14.6	Kaus Aust.	83 55.1	S34 23.0
	17	124 18.2	45 59.6	13.3	46 28.8	51.5	20 27.1	03.2	50 39.2	14.7			
	18	139 20.7	60 58.8	N24 13.6	61 29.5	N23 51.7	35 29.1	N23 03.2	65 41.3	N21 14.7	Kochab	137 18.2	N74 08.9
	19	154 23.1	75 57.9	14.0	76 30.1	51.9	50 31.1	03.1	80 43.5	14.7	Markab	13 47.2	N15 12.8
	20	169 25.6	90 57.1	14.3	91 30.8	52.0	65 33.0	03.1	95 45.6	14.8	Menkar	314 24.6	N 4 05.8
	21	184 28.1	105 56.3	. . 14.6	106 31.4	. . 52.2	80 35.0	. . 03.0	110 47.7	. . 14.8	Menkent	148 17.6	S36 22.9
	22	199 30.5	120 55.5	15.0	121 32.1	52.3	95 37.0	03.0	125 49.9	14.9	Miaplacidus	221 41.8	S69 43.8
	23	214 33.0	135 54.6	15.3	136 32.7	52.5	110 39.0	03.0	140 52.0	14.9			
	12 00	229 35.5	150 53.8	N24 15.6	151 33.4	N23 52.6	125 41.0	N23 02.9	155 54.2	N21 14.9	Mirfak	308 53.5	N49 52.1
	01	244 37.9	165 53.0	16.0	166 34.0	52.8	140 43.0	02.9	170 56.3	15.0	Nunki	76 08.9	S26 17.6
	02	259 40.4	180 52.2	16.3	181 34.7	52.9	155 45.0	02.9	185 58.4	15.0	Peacock	53 32.7	S56 43.5
	03	274 42.9	195 51.3	. . 16.6	196 35.3	. . 53.1	170 46.9	. . 02.8	201 00.6	. . 15.0	Pollux	243 38.6	N28 01.4
	04	289 45.3	210 50.5	17.0	211 35.9	53.2	185 48.9	02.8	216 02.7	15.1	Procyon	245 09.1	N 5 13.1
	05	304 47.8	225 49.7	17.3	226 36.6	53.4	200 50.9	02.7	231 04.8	15.1			
	06	319 50.3	240 48.9	N24 17.6	241 37.2	N23 53.5	215 52.9	N23 02.7	246 07.0	N21 15.2	Rasalhague	96 14.3	N12 33.4
	07	334 52.7	255 48.0	17.9	256 37.9	53.7	230 54.9	02.7	261 09.1	15.2	Regulus	207 52.8	N11 57.4
	08	349 55.2	270 47.2	18.3	271 38.5	53.8	245 56.9	02.6	276 11.2	15.2	Rigel	281 20.8	S 8 12.0
S	09	4 57.6	285 46.4	. . 18.6	286 39.2	. . 54.0	260 58.8	. . 02.6	291 13.4	. . 15.3	Rigil Kent.	140 03.3	S60 50.7
U	10	20 00.1	300 45.5	18.9	301 39.8	54.1	276 00.8	02.5	306 15.5	15.3	Sabik	102 22.3	S15 43.7
N	11	35 02.6	315 44.7	19.2	316 40.5	54.3	291 02.8	02.5	321 17.7	15.4			
D	12	50 05.0	330 43.9	N24 19.5	331 41.1	N23 54.4	306 04.8	N23 02.5	336 19.8	N21 15.4	Schedar	349 51.2	N56 32.7
A	13	65 07.5	345 43.1	19.9	346 41.8	54.6	321 06.8	02.4	351 21.9	15.4	Shaula	96 33.5	S37 06.3
Y	14	80 10.0	0 42.2	20.2	1 42.4	54.7	336 08.8	02.4	6 24.1	15.5	Sirius	258 41.7	S16 43.3
	15	95 12.4	15 41.4	. . 20.5	16 43.1	. . 54.8	351 10.7	. . 02.3	21 26.2	. . 15.5	Spica	158 40.2	S11 10.4
	16	110 14.9	30 40.6	20.8	31 43.7	55.0	6 12.7	02.3	36 28.3	15.6	Suhail	222 59.0	S43 26.7
	17	125 17.4	45 39.8	21.1	46 44.4	55.1	21 14.7	02.3	51 30.5	15.6			
	18	140 19.8	60 38.9	N24 21.4	61 45.0	N23 55.3	36 16.7	N23 02.2	66 32.6	N21 15.6	Vega	80 44.6	N38 46.9
	19	155 22.3	75 38.1	21.7	76 45.7	55.4	51 18.7	02.2	81 34.7	15.7	Zuben'ubi	137 14.8	S16 03.1
	20	170 24.8	90 37.3	22.0	91 46.3	55.6	66 20.7	02.1	96 36.9	15.7		SHA	Mer. Pass.
	21	185 27.2	105 36.4	. . 22.3	106 47.0	. . 55.7	81 22.6	. . 02.1	111 39.0	. . 15.8		° ′	h m
	22	200 29.7	120 35.6	22.6	121 47.6	55.9	96 24.6	02.1	126 41.2	15.8	Venus	282 37.2	13 56
	23	215 32.1	135 34.8	23.0	136 48.3	56.0	111 26.6	02.0	141 43.3	15.8	Mars	282 41.5	13 54
	Mer. Pass.	8 44.1	v −0.8	d 0.3	v 0.6	d 0.2	v 2.0	d 0.0	v 2.1	d 0.0	Jupiter Saturn	256 17.0 286 26.5	15 38 13 38

2002 MAY 10, 11, 12 (FRI., SAT., SUN.) 97

	UT	SUN		MOON				
	d h	GHA	Dec	GHA	v	Dec	d	HP
	10 00	180 54.3	N17 31.0	205 56.8	16.1	N 4 25.8	12.5	54.4
	01	195 54.3	31.6	220 31.9	16.1	4 38.3	12.4	54.4
	02	210 54.3	32.3	235 07.0	16.0	4 50.7	12.5	54.4
	03	225 54.3	. . 32.9	249 42.0	16.0	5 03.2	12.5	54.4
	04	240 54.4	33.6	264 17.0	16.0	5 15.7	12.4	54.4
	05	255 54.4	34.3	278 52.0	16.0	5 28.1	12.5	54.4
	06	270 54.4	N17 34.9	293 27.0	15.9	N 5 40.6	12.4	54.5
	07	285 54.4	35.6	308 01.9	15.9	5 53.0	12.4	54.5
	08	300 54.5	36.2	322 36.8	15.8	6 05.4	12.4	54.5
F	09	315 54.5	. . 36.9	337 11.6	15.8	6 17.8	12.3	54.5
R	10	330 54.5	37.5	351 46.4	15.8	6 30.1	12.4	54.5
I	11	345 54.5	38.2	6 21.2	15.7	6 42.5	12.3	54.5
D	12	0 54.5	N17 38.8	20 55.9	15.7	N 6 54.8	12.3	54.5
A	13	15 54.6	39.5	35 30.6	15.7	7 07.1	12.3	54.5
Y	14	30 54.6	40.2	50 05.3	15.6	7 19.4	12.3	54.6
	15	45 54.6	. . 40.8	64 39.9	15.5	7 31.7	12.2	54.6
	16	60 54.6	41.5	79 14.4	15.6	7 43.9	12.3	54.6
	17	75 54.7	42.1	93 49.0	15.4	7 56.2	12.2	54.6
	18	90 54.7	N17 42.8	108 23.4	15.5	N 8 08.4	12.1	54.6
	19	105 54.7	43.4	122 57.9	15.4	8 20.5	12.2	54.6
	20	120 54.7	44.1	137 32.3	15.3	8 32.7	12.1	54.6
	21	135 54.7	. . 44.7	152 06.6	15.3	8 44.8	12.1	54.7
	22	150 54.8	45.4	166 40.9	15.3	8 56.9	12.1	54.7
	23	165 54.8	46.0	181 15.2	15.2	9 09.0	12.0	54.7
	11 00	180 54.8	N17 46.6	195 49.4	15.2	N 9 21.0	12.0	54.7
	01	195 54.8	47.3	210 23.6	15.1	9 33.0	12.0	54.7
	02	210 54.8	47.9	224 57.7	15.0	9 45.0	11.9	54.7
	03	225 54.9	. . 48.6	239 31.7	15.0	9 56.9	11.9	54.7
	04	240 54.9	49.2	254 05.7	15.0	10 08.8	11.9	54.8
	05	255 54.9	49.9	268 39.7	14.9	10 20.7	11.8	54.8
	06	270 54.9	N17 50.5	283 13.6	14.9	N10 32.5	11.8	54.8
	07	285 54.9	51.2	297 47.5	14.8	10 44.3	11.8	54.8
S	08	300 54.9	51.8	312 21.3	14.7	10 56.1	11.7	54.8
A	09	315 55.0	. . 52.5	326 55.0	14.7	11 07.8	11.7	54.8
T	10	330 55.0	53.1	341 28.7	14.6	11 19.5	11.7	54.9
U	11	345 55.0	53.7	356 02.3	14.6	11 31.2	11.6	54.9
R	12	0 55.0	N17 54.4	10 35.9	14.5	N11 42.8	11.6	54.9
D	13	15 55.0	55.0	25 09.4	14.4	11 54.4	11.5	54.9
A	14	30 55.0	55.7	39 42.8	14.4	12 05.9	11.5	54.9
Y	15	45 55.0	. . 56.3	54 16.2	14.4	12 17.4	11.5	54.9
	16	60 55.1	56.9	68 49.6	14.2	12 28.9	11.4	54.9
	17	75 55.1	57.6	83 22.8	14.3	12 40.3	11.3	55.0
	18	90 55.1	N17 58.2	97 56.1	14.1	N12 51.6	11.3	55.0
	19	105 55.1	58.8	112 29.2	14.1	13 02.9	11.3	55.0
	20	120 55.1	17 59.5	127 02.3	14.0	13 14.2	11.2	55.0
	21	135 55.1	18 00.1	141 35.3	14.0	13 25.4	11.1	55.0
	22	150 55.1	00.8	156 08.3	13.9	13 36.5	11.2	55.0
	23	165 55.2	01.4	170 41.2	13.8	13 47.7	11.0	55.1
	12 00	180 55.2	N18 02.0	185 14.0	13.7	N13 58.7	11.0	55.1
	01	195 55.2	02.7	199 46.7	13.7	14 09.7	11.0	55.1
	02	210 55.2	03.3	214 19.4	13.7	14 20.7	10.9	55.1
	03	225 55.2	. . 03.9	228 52.1	13.5	14 31.6	10.8	55.1
	04	240 55.2	04.6	243 24.6	13.5	14 42.4	10.8	55.2
	05	255 55.2	05.2	257 57.1	13.4	14 53.2	10.7	55.2
	06	270 55.2	N18 05.8	272 29.5	13.4	N15 03.9	10.7	55.2
	07	285 55.3	06.5	287 01.9	13.3	15 14.6	10.6	55.2
	08	300 55.3	07.1	301 34.2	13.2	15 25.2	10.5	55.2
S	09	315 55.3	. . 07.7	316 06.4	13.1	15 35.7	10.5	55.2
U	10	330 55.3	08.3	330 38.5	13.1	15 46.2	10.5	55.3
N	11	345 55.3	09.0	345 10.6	13.0	15 56.7	10.3	55.3
D	12	0 55.3	N18 09.6	359 42.6	12.9	N16 07.0	10.3	55.3
A	13	15 55.3	10.2	14 14.5	12.8	16 17.3	10.2	55.3
Y	14	30 55.3	10.9	28 46.3	12.8	16 27.5	10.2	55.3
	15	45 55.3	. . 11.5	43 18.1	12.7	16 37.7	10.1	55.3
	16	60 55.4	12.1	57 49.8	12.6	16 47.8	10.0	55.4
	17	75 55.4	12.7	72 21.4	12.6	16 57.8	9.9	55.4
	18	90 55.4	N18 13.4	86 53.0	12.4	N17 07.7	9.9	55.4
	19	105 55.4	14.0	101 24.4	12.4	17 17.6	9.8	55.4
	20	120 55.4	14.6	115 55.8	12.4	17 27.4	9.8	55.4
	21	135 55.4	. . 15.2	130 27.2	12.2	17 37.2	9.6	55.5
	22	150 55.4	15.9	144 58.4	12.2	17 46.8	9.6	55.5
	23	165 55.4	16.5	159 29.6	12.1	N17 56.4	9.5	55.5
		SD 15.9	d 0.6	SD 14.9		15.0		15.1

Lat.	Twilight		Sunrise	Moonrise			
	Naut.	Civil		10	11	12	13
°	h m	h m	h m	h m	h m	h m	h m
N 72	▭	▭	▭	03 19	02 53	02 17	▭
N 70	////	////	01 25	03 26	03 08	02 45	02 06
68	////	////	02 10	03 31	03 20	03 06	02 47
66	////	00 28	02 39	03 36	03 30	03 23	03 15
64	////	01 35	03 01	03 40	03 38	03 37	03 37
62	////	02 09	03 18	03 44	03 46	03 49	03 55
60	00 25	02 33	03 33	03 47	03 52	03 59	04 09
N 58	01 25	02 52	03 45	03 50	03 58	04 08	04 22
56	01 56	03 07	03 55	03 52	04 03	04 16	04 32
54	02 19	03 20	04 05	03 54	04 07	04 23	04 42
52	02 36	03 32	04 13	03 56	04 11	04 29	04 51
50	02 51	03 42	04 20	03 58	04 15	04 35	04 58
45	03 20	04 02	04 36	04 02	04 23	04 47	05 15
N 40	03 42	04 19	04 49	04 06	04 30	04 57	05 28
35	03 59	04 32	05 00	04 09	04 36	05 06	05 40
30	04 12	04 44	05 09	04 11	04 41	05 14	05 50
20	04 35	05 02	05 26	04 16	04 50	05 27	06 07
N 10	04 52	05 18	05 40	04 20	04 58	05 39	06 23
0	05 06	05 31	05 53	04 24	05 06	05 50	06 37
S 10	05 18	05 44	06 06	04 28	05 14	06 01	06 52
20	05 30	05 56	06 20	04 32	05 22	06 13	07 07
30	05 41	06 10	06 35	04 37	05 31	06 27	07 25
35	05 47	06 17	06 44	04 40	05 37	06 35	07 36
40	05 53	06 25	06 54	04 43	05 43	06 45	07 48
45	05 59	06 35	07 06	04 46	05 50	06 56	08 02
S 50	06 06	06 46	07 21	04 51	05 59	07 09	08 20
52	06 09	06 50	07 28	04 53	06 03	07 15	08 28
54	06 13	06 56	07 35	04 55	06 08	07 22	08 38
56	06 16	07 02	07 43	04 58	06 13	07 30	08 48
58	06 20	07 08	07 53	05 01	06 18	07 38	09 00
S 60	06 24	07 15	08 04	05 04	06 24	07 48	09 15

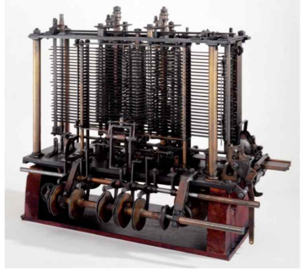
Lat.	Sunset	Twilight		Moonset			
		Civil	Naut.	10	11	12	13
°	h m	h m	h m	h m	h m	h m	h m
N 72	▭	▭	▭	18 32	20 39	▭	▭
N 70	22 35	////	////	18 19	20 12	22 27	▭
68	21 47	////	////	18 09	19 52	21 47	24 15
66	21 17	////	////	18 00	19 37	21 20	23 14
64	20 54	22 23	////	17 53	19 24	20 59	22 40
62	20 37	21 47	////	17 47	19 13	20 43	22 15
60	20 22	21 22	////	17 42	19 04	20 29	21 55
N 58	20 09	21 03	22 32	17 37	18 56	20 17	21 39
56	19 59	20 47	22 00	17 33	18 49	20 07	21 25
54	19 49	20 34	21 36	17 30	18 43	19 58	21 14
52	19 41	20 22	21 18	17 26	18 37	19 50	21 03
50	19 33	20 12	21 03	17 23	18 32	19 43	20 54
45	19 17	19 51	20 34	17 17	18 21	19 27	20 35
N 40	19 04	19 35	20 12	17 12	18 12	19 15	20 19
35	18 53	19 21	19 55	17 07	18 05	19 04	20 05
30	18 44	19 10	19 41	17 03	17 58	18 55	19 54
20	18 27	18 51	19 18	16 56	17 46	18 39	19 34
N 10	18 13	18 35	19 01	16 50	17 36	18 25	19 17
0	18 00	18 22	18 47	16 44	17 27	18 12	19 01
S 10	17 47	18 09	18 34	16 38	17 17	18 00	18 45
20	17 33	17 56	18 23	16 32	17 07	17 46	18 28
30	17 17	17 42	18 11	16 25	16 56	17 30	18 09
35	17 08	17 35	18 05	16 21	16 50	17 21	17 57
40	16 58	17 27	17 59	16 17	16 42	17 11	17 45
45	16 46	17 17	17 53	16 11	16 33	16 59	17 29
S 50	16 31	17 07	17 46	16 05	16 23	16 44	17 11
52	16 25	17 02	17 43	16 02	16 18	16 38	17 02
54	16 17	16 56	17 39	15 59	16 13	16 30	16 52
56	16 09	16 50	17 36	15 56	16 07	16 22	16 41
58	15 59	16 44	17 32	15 52	16 01	16 12	16 28
S 60	15 48	16 36	17 28	15 48	15 54	16 02	16 14

Day	SUN			MOON			
	Eqn. of Time 00^{h}	12^{h}	Mer. Pass.	Mer. Pass. Upper	Lower	Age	Phase
d	m s	m s	h m	h m	h m	d	%
10	03 37	03 38	11 56	10 34	22 55	28	4
11	03 39	03 40	11 56	11 16	23 38	29	1 ●
12	03 41	03 41	11 56	12 01	24 25	00	0

12

Programmable devices

- Charles Babbage designed the Analytical Engine, a mechanical, programmable computer in 19th Century
  - It was never built in Babbage's time due to a lack of manufacturing capabilities (ahead of his time!)
  - Design called for punched cards to be fed into the machine to program it to perform mathematical calculations
  - Output would go to a printer or punched cards
  - See for details: https://www.thoughtco.com/first-computer-charles-babbages-1221836



13

Programmable computers

- Many others
- Now, move forward to the 20th and 21st centuries
- A modern computer has three basic requirements:

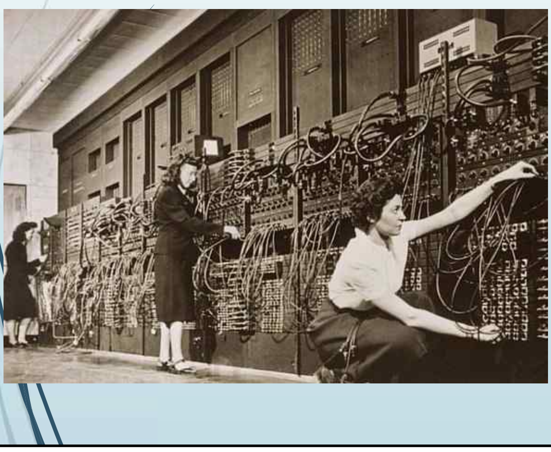
1. Must be electronic and not exclusively mechanical.
2. Must be digital, not analog
   - Uses discrete values (digits), not a continuous range of values to represent data. (i.e. digital vs mercury-based thermometer)
3. Must employ the **stored-program concept**
   - the device can be reprogrammed by changing the instructions stored in the memory of the computer

13

14

Programmable computers

- ENIAC (Electronic Numerical Integrator and Computer)
  - Built in the 1940s
  - Among the first computers to employ the stored-program concept



14

15

Programmable computers

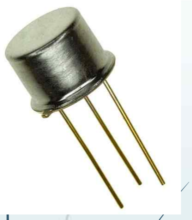
- Again, the **stored-program concept** is the idea that programs (software) along with their data are *stored* (saved) in the memory of a computer
  - Not referring to storage on hard drives, flash drives or CDs
  - Referring to **main memory** of the computer, sometimes called the **RAM** (random access memory)
- A modern processor
  - reads the **machine instructions** *stored* as 1s and 0s in the main memory
  - executes those instructions in sequence
  - Key point: these instructions can be changed to easily reprogram the computer to do new tasks

➨ A typical processor has a thousand or more different machine instructions.

15

16

Transistors



- A variety of devices have been used to represent digits and to control the operation of computing machines
- In the 1940s:
  - Bardeen, Brattain, and Shockley invented the **transistor**, which is an electronic switch with no moving parts
- In the 1950s and 1960s:
  - Kilby, Noyce, and others used transistors to develop **integrated circuits**
  - Devised a way to manufacture thousands – later, millions and billions – of transistors on a single wafer of silicon
- A single **chip** contains:
  - an integrated circuit
  - a ceramic or plastic case
  - external pins to attach it to a **circuit board**

16

17

Transistors

Noyce and businessman Gordon Moore commercialized this technology by co-founding Intel Corporation in 1968

Manufacturing technologies improved in the 1950s and 1960s:

engineers were able to pack many more transistors per unit area on silicon wafers

Moore's law: Moore observed that the number of components within an integrated circuit was doubling every 18 months.

- The trend has continued pretty steadily since then.

Combating miniaturization challenges:

Intel, AMD (Advanced Micro Devices) and others now make processors that feature multiple processing **cores** that perform calculations in parallel with each other

17

18

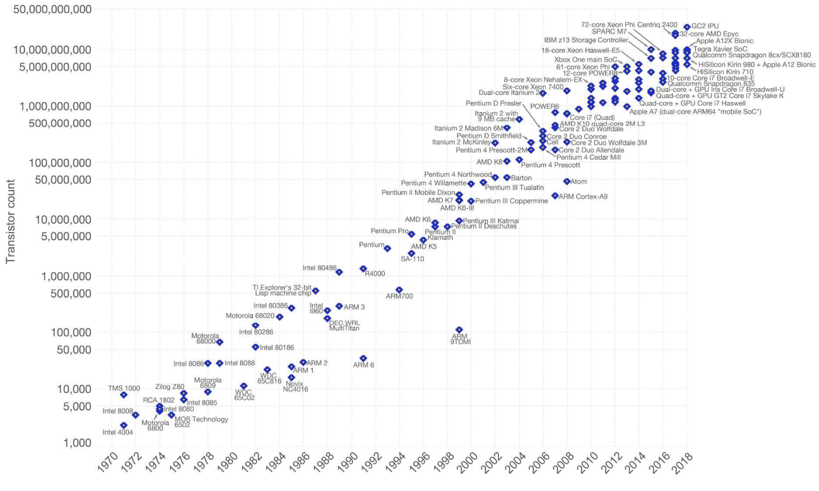
Moore's Law

Figure taken from:

OurWorldinData

Moore's Law – The number of transistors on integrated circuit chips (1971-2018)

Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important as other aspects of technological progress – such as processing speed or the price of electronic products – are linked to Moore's law.



Data source: Wikipedia (https://en.wikipedia.org/wiki/Transistor_count)
The data visualization is available at OurWorldinData.org. There you find more visualizations and research on this topic.

18

19

Computing systems

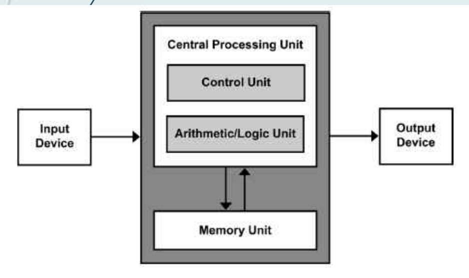
- A computing system consists of two major parts: the **hardware** and the **software**
- Some hardware elements of a computer
  - Screen, keyboard, mouse
  - Central processing unit, main memory
  - Hard drives and other storage units
- Type of software in use
  - Applications software, like office productivity programs, video games, web browsers
  - Systems software, like operating systems, database systems

19

20

Modern computer architecture

- The stored program approach used today is implemented using **von Neumann architecture**, named after U.S. mathematician John von Neumann
- This architecture contains input devices, output devices, a processor and a memory unit



- Will now look at how they work together to form a functioning computer

20

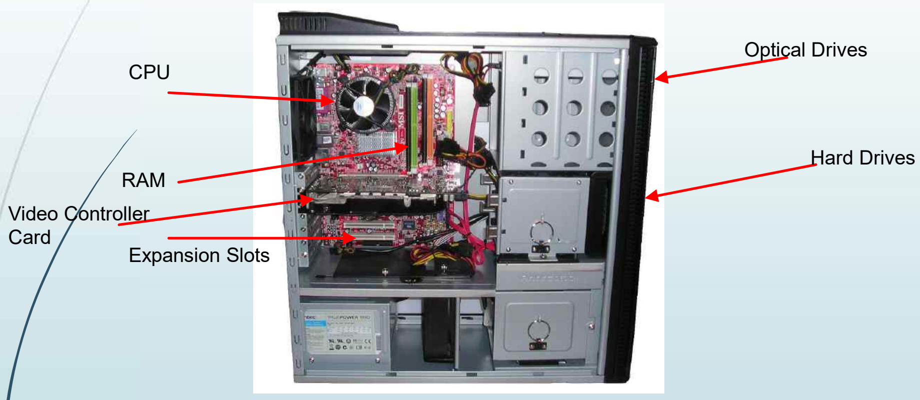
21

Modern computer architecture

- In modern computers (PCs), the major components in a von Neumann machine reside physically in a circuit board called the **motherboard**
  - The CPU, memory, expansion cards and other components are plugged into slots so they can be replaced
  - Hard drives, CD drives, and other storage devices are connected to the motherboard through cables
- The central processing unit is the “brain” of the machine
  - its **arithmetic/logic unit** (ALU) performs millions or billions of calculations per second
  - The **control unit** is the main organizing force of the computer and directs the operation of the ALU

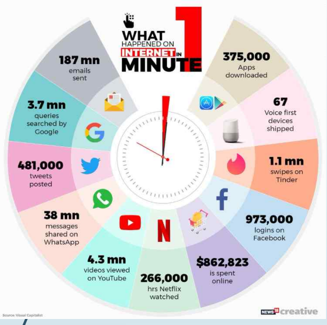
22

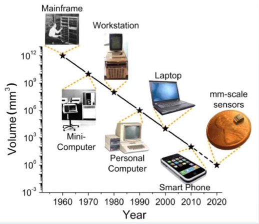
Modern computer architecture



23

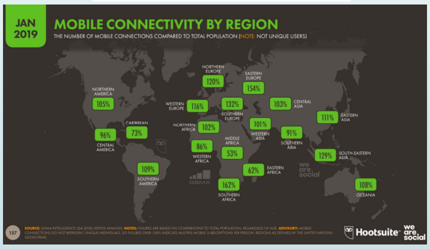
The information explosion in 21st century





https://www.internetlivestats.com/

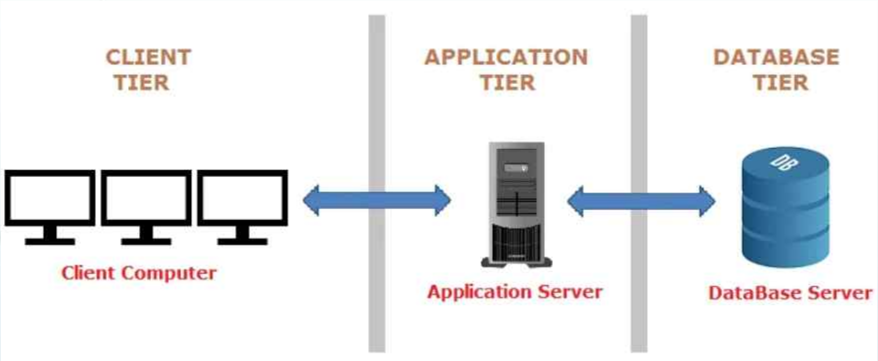
- Figure 1 source: https://www.visualcapitalist.com/what-happens-in-an-internet-minute-in-2019/
- Figure 2 source: https://wearesocial.com/global-digital-report-2019


JAN 2019
MOBILE CONNECTIVITY BY REGION
THE NUMBER OF MOBILE CONNECTIONS COMPARED TO TOTAL POPULATION (NOTE: NOT UNIQUE USERS)
NORTHERN EUROPE 120%
EASTERN EUROPE 154%
NORTHERN AMERICA 105%
WESTERN EUROPE 116%
SOUTHERN EUROPE 132%
CENTRAL ASIA 103%
EASTERN ASIA 111%
CARIBBEAN 73%
NORTHERN AFRICA 102%
WESTERN ASIA 101%
CENTRAL AMERICA 96%
SOUTHERN ASIA 91%
WESTERN AFRICA 86%
MIDDLE AFRICA 53%
SOUTH-EASTERN ASIA 129%
SOUTHERN AMERICA 109%
EASTERN AFRICA 62%
SOUTHERN AFRICA 162%
OCEANIA 108%
157
SOURCE: GSMA INTELLIGENCE (Q4 2018); KEPIOS ANALYSIS. NOTES: FIGURES ARE BASED ON COMPARISONS TO TOTAL POPULATION, REGARDLESS OF AGE. ADVISORY: MOBILE CONNECTIONS DO NOT REPRESENT UNIQUE INDIVIDUALS, SO FIGURES OVER 100% INDICATE MULTIPLE MOBILE SUBSCRIPTIONS PER PERSON. REGIONS AS DEFINED BY THE UNITED NATIONS GEOSCHEME.
Hootsuite
we are social

23

24

3-Tier Application Architecture



CLIENT TIER

APPLICATION TIER

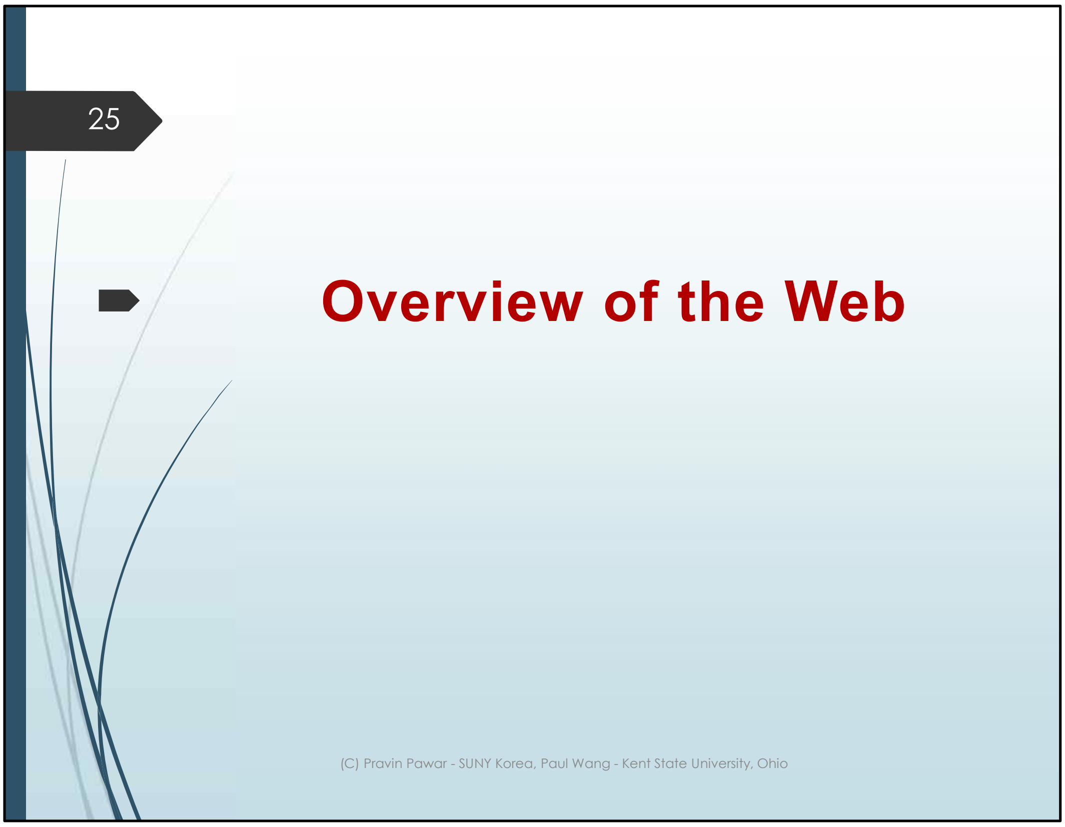
DATABASE TIER

Client Computer

Application Server

DataBase Server

24

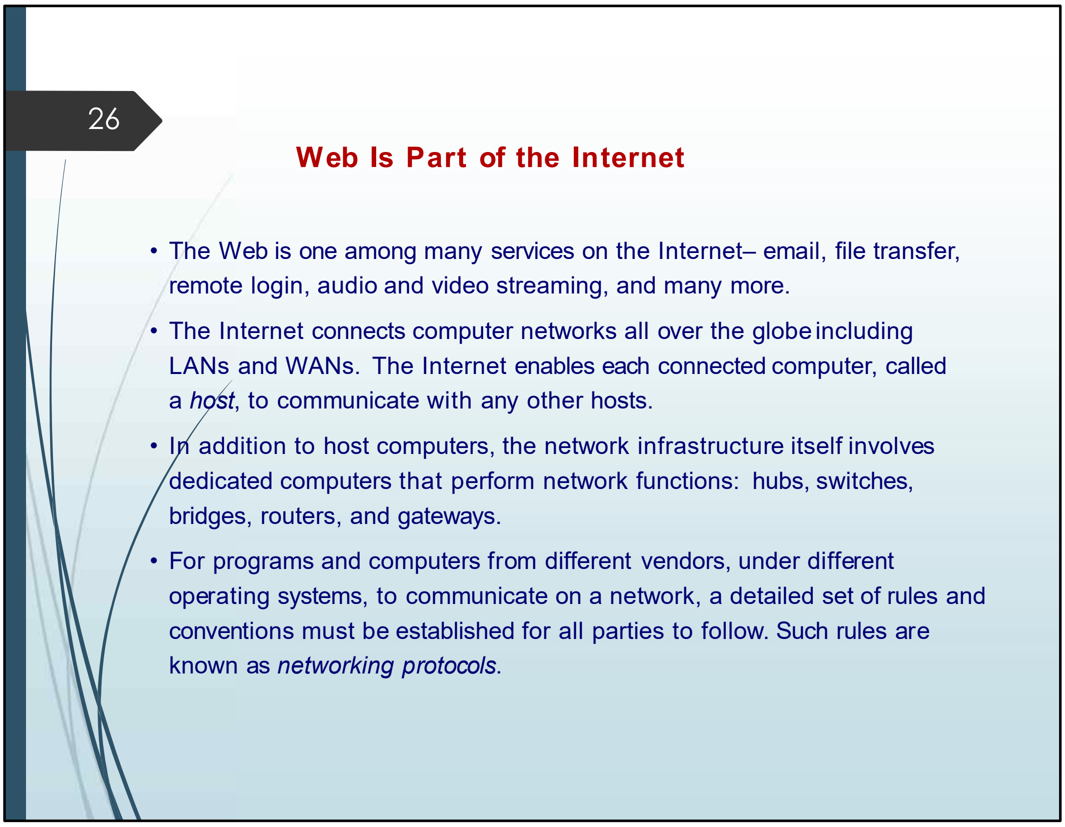


25

Overview of the Web

(C) Pravin Pawar - SUNY Korea, Paul Wang - Kent State University, Ohio

25



26

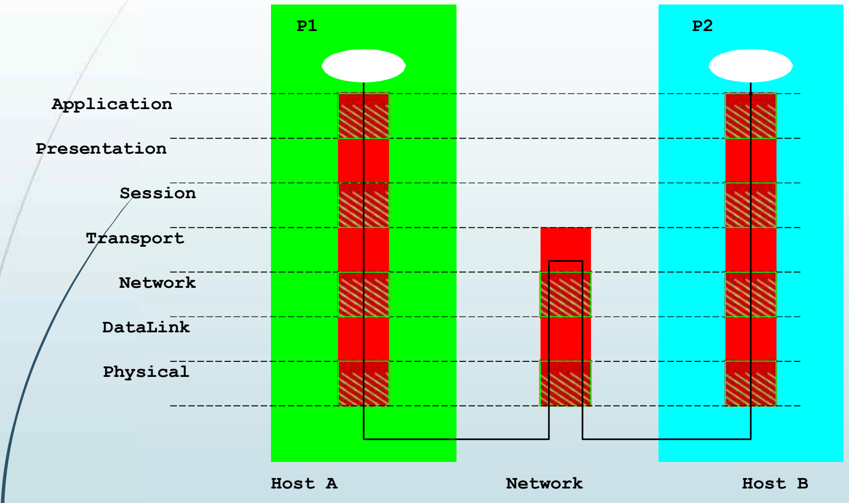
Web Is Part of the Internet

- The Web is one among many services on the Internet– email, file transfer, remote login, audio and video streaming, and many more.
- The Internet connects computer networks all over the globe including LANs and WANs. The Internet enables each connected computer, called a *host*, to communicate with any other hosts.
- In addition to host computers, the network infrastructure itself involves dedicated computers that perform network functions: hubs, switches, bridges, routers, and gateways.
- For programs and computers from different vendors, under different operating systems, to communicate on a network, a detailed set of rules and conventions must be established for all parties to follow. Such rules are known as *networking protocols*.

26

27

Networking Layers



27

28

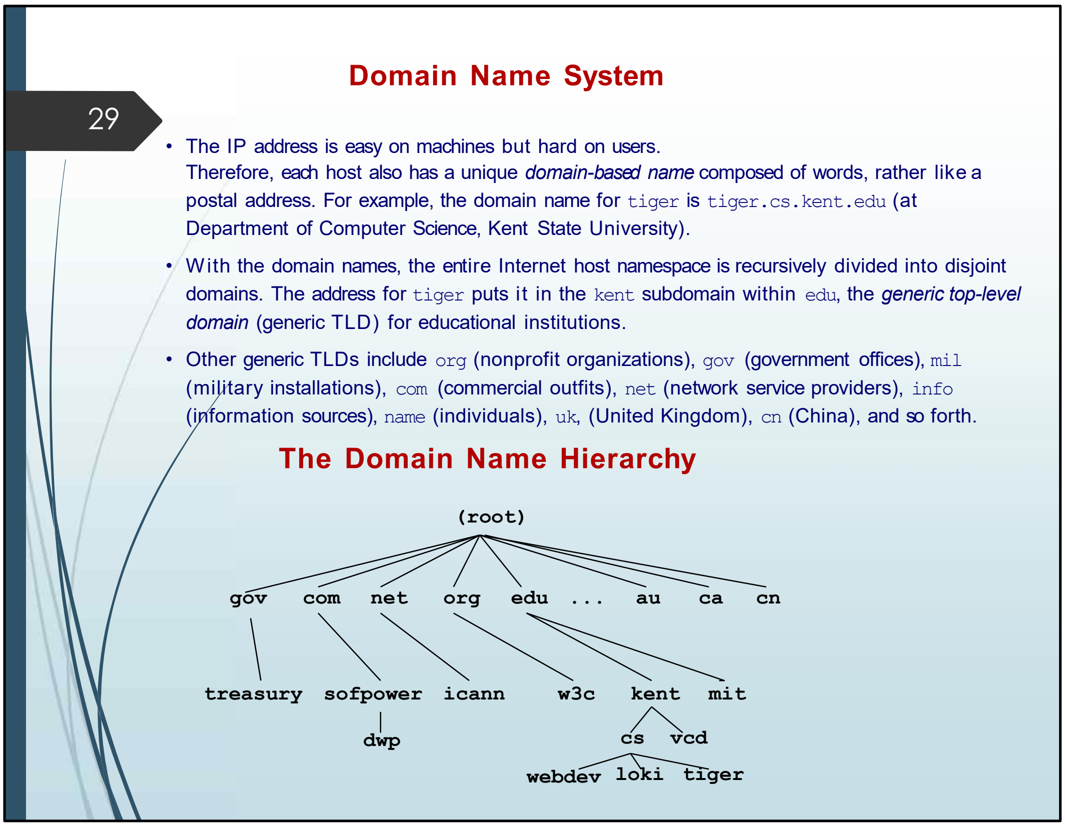
IP Address

10000011	01111011	00100110	10101100
131	123	38	172

- On the Internet, each host has a unique *IP address* For example, `tiger`, a host at Kent State, has the IP address `131.123.38.172`.
- This *dot notation* (or *quad notation*) gives the decimal value (0 to 255) of each byte.
- Similar to a telephone number, the leading digits of an IP address are like country codes and area codes while the trailing digits are like local numbers.
- A host may be configured with a fixed IP or may obtain an IP address assigned to it on-the-fly as it boots up and attempts to connect to the network initially.

Tracert command

28



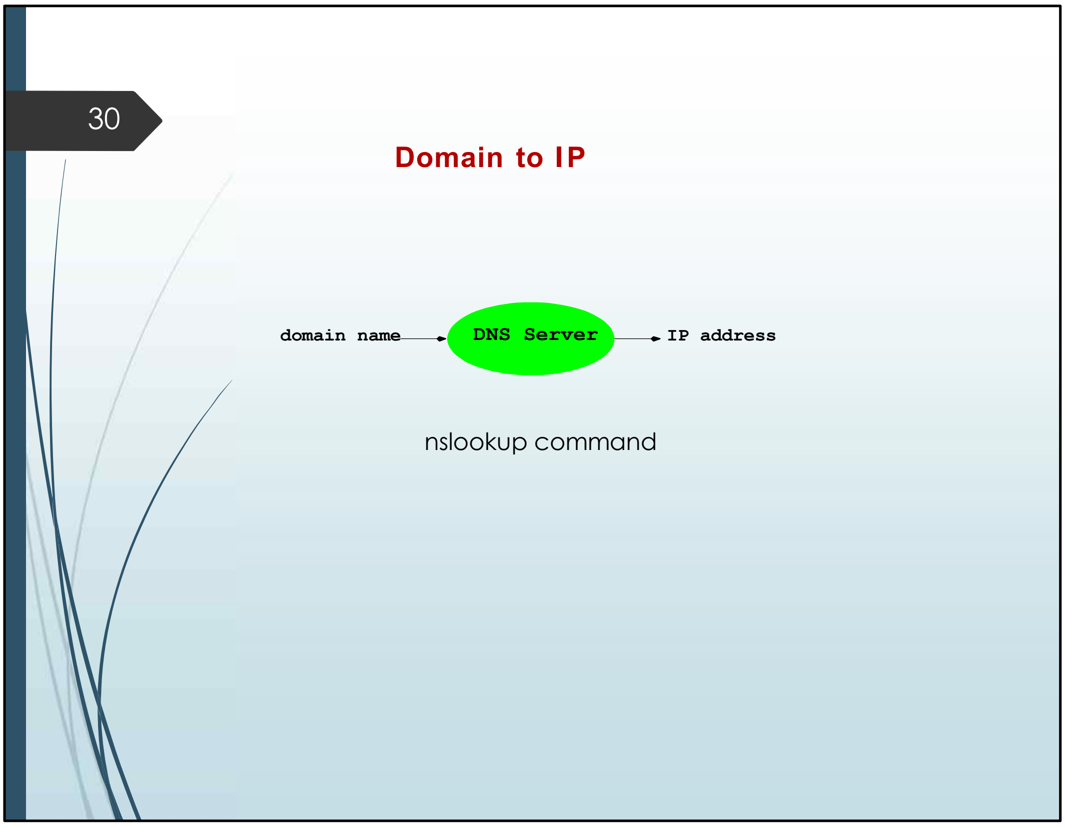
29

Domain Name System

- The IP address is easy on machines but hard on users. Therefore, each host also has a unique *domain-based name* composed of words, rather like a postal address. For example, the domain name for `tiger` is `tiger.cs.kent.edu` (at Department of Computer Science, Kent State University).
- With the domain names, the entire Internet host namespace is recursively divided into disjoint domains. The address for `tiger` puts it in the `kent` subdomain within `edu`, the *generic top-level domain* (generic TLD) for educational institutions.
- Other generic TLDs include `org` (nonprofit organizations), `gov` (government offices), `mil` (military installations), `com` (commercial outfits), `net` (network service providers), `info` (information sources), `name` (individuals), `uk`, (United Kingdom), `cn` (China), and so forth.

The Domain Name Hierarchy

29



30

Domain to IP

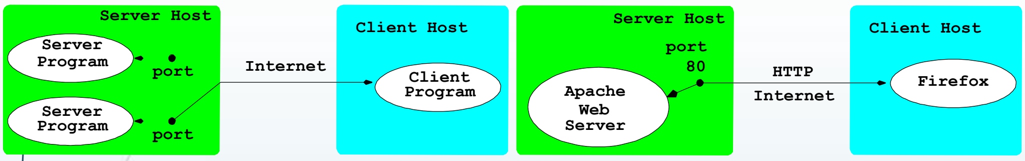
domain name
DNS Server
IP address

nslookup command

30

31

Client and Server



- A *server* program provides a specific service on a host (the server host) that offers such a service. Example services are email (SMTP), secure remote login/file transfer (SSH/SFTP), and the World Wide Web (HTTP).
- Each *standard Internet service* has its own unique *port number* that is identical across all server hosts. The port number together with the IP address of a host identifies a particular server program. For example, SMTP uses port number 25, SSH/SFTP 22, and HTTP 80.
- A *client* program on a computer connects with a server on another host to obtain its service. Thus, a client program is the agent through which a particular network service can be obtained. Different agents are usually required for different services. Example clients are Mozilla Thunderbird® and Microsoft® Outlook® for email, OpenSSH for secure login/file transfer.

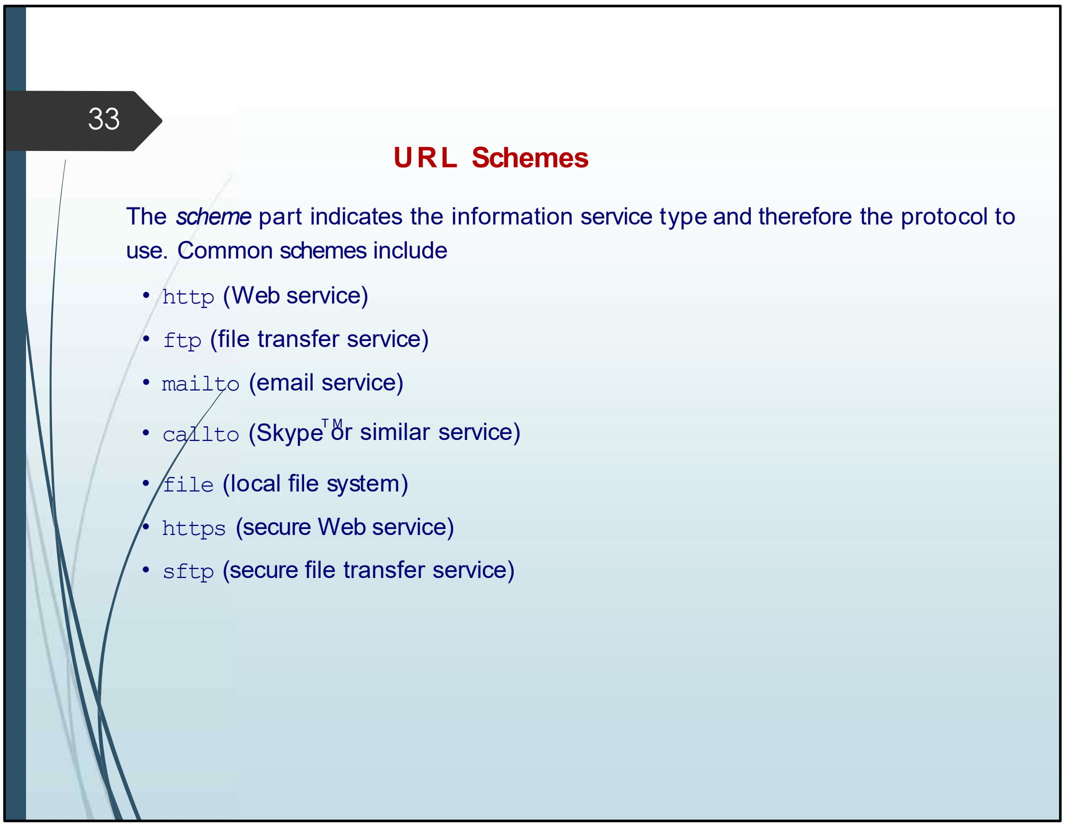
32

URLs

- The Web uses *Uniform Resource Locators* (URLs) to identify (locate) many kinds of resources (files and services) available on the Internet.
- A URL may identify a host, a server port, and the target file stored on that host. URLs are used, for example, by browsers to retrieve information, and in HTML documents to link to other resources.
- A full URL usually has the form

  scheme://*server*:*port*/*pathname*?*query_string*

  E.g https://www.google.com/search?q=Government+of+Korea
- URLs are contained in webpages to create links to image, audio, video, and any other type of files anywhere on the Web



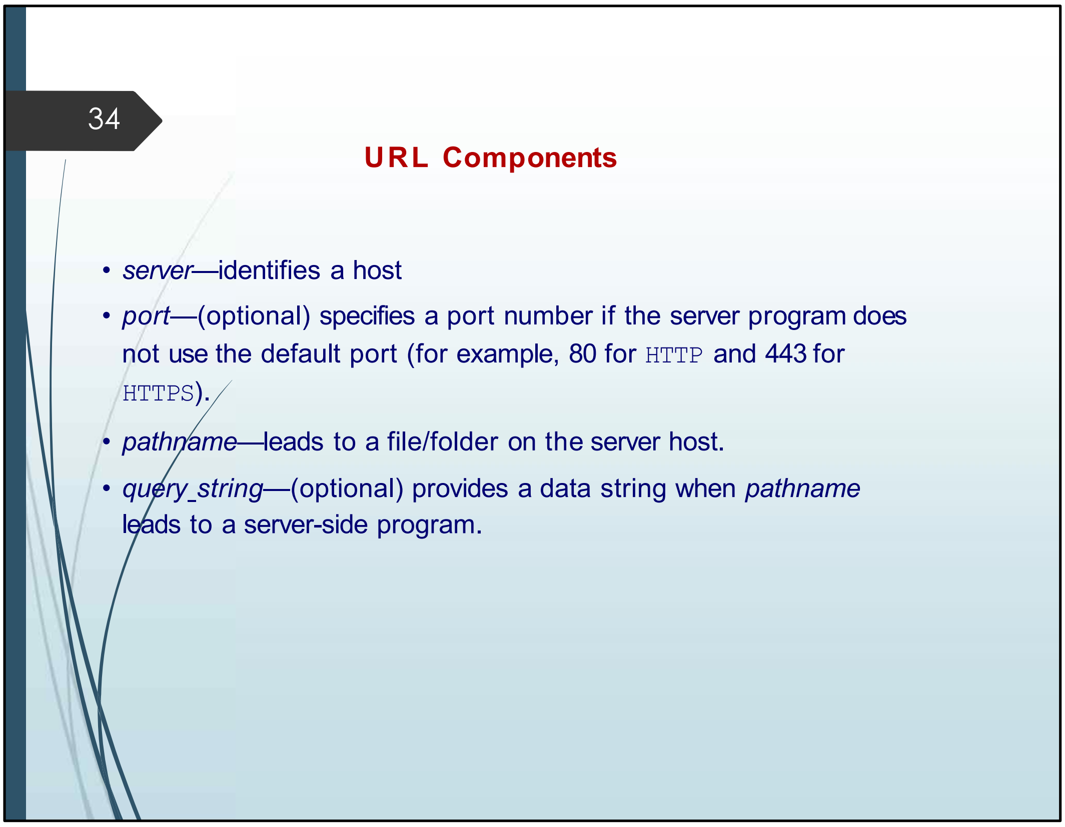
33

URL Schemes

The *scheme* part indicates the information service type and therefore the protocol to use. Common schemes include

- `http` (Web service)
- `ftp` (file transfer service)
- `mailto` (email service)
- `callto` (Skype™ or similar service)
- `file` (local file system)
- `https` (secure Web service)
- `sftp` (secure file transfer service)

33

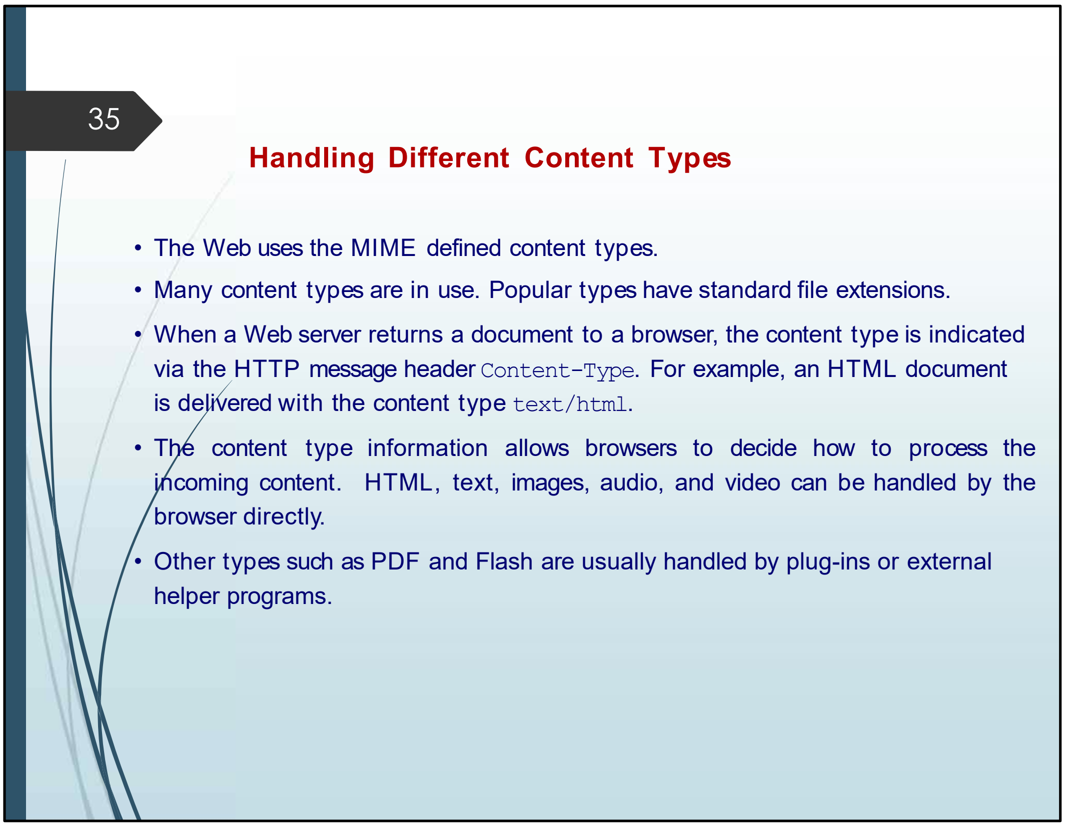


34

URL Components

- *server*—identifies a host
- *port*—(optional) specifies a port number if the server program does not use the default port (for example, 80 for `HTTP` and 443 for `HTTPS`).
- *pathname*—leads to a file/folder on the server host.
- *query_string*—(optional) provides a data string when *pathname* leads to a server-side program.

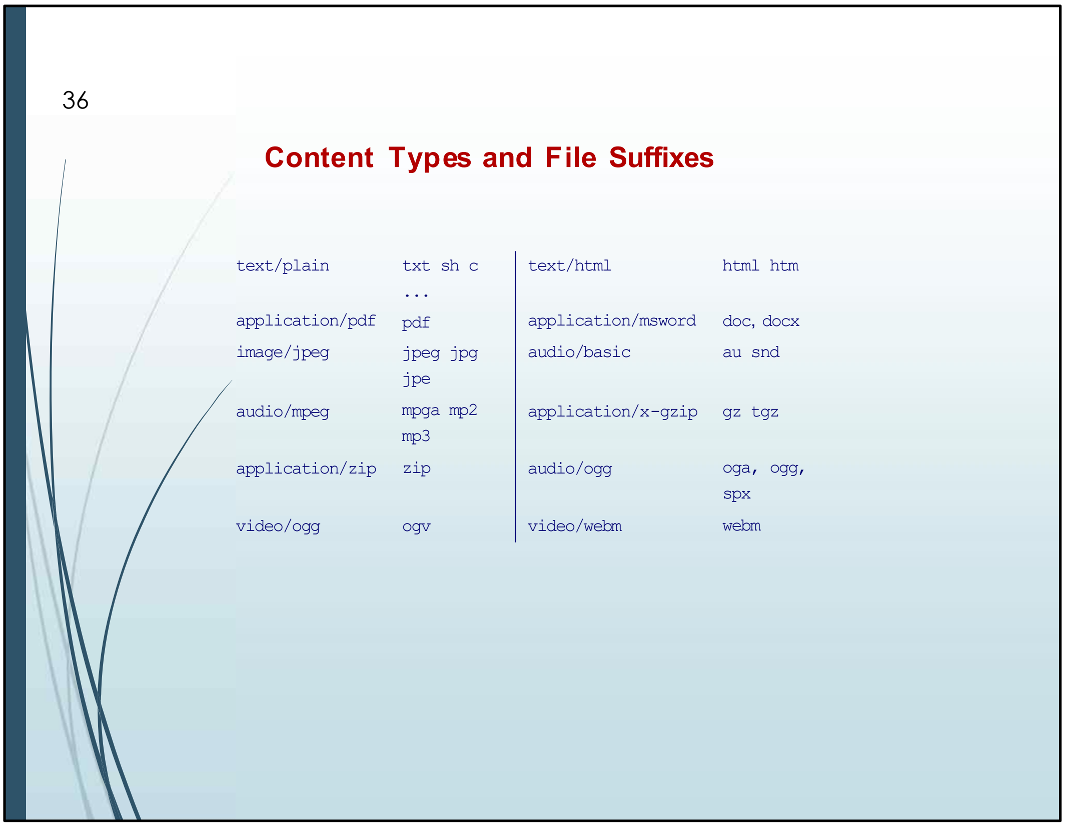
34



35

Handling Different Content Types

- The Web uses the MIME defined content types.
- Many content types are in use. Popular types have standard file extensions.
- When a Web server returns a document to a browser, the content type is indicated via the HTTP message header `Content-Type`. For example, an HTML document is delivered with the content type `text/html`.
- The content type information allows browsers to decide how to process the incoming content. HTML, text, images, audio, and video can be handled by the browser directly.
- Other types such as PDF and Flash are usually handled by plug-ins or external helper programs.



36

Content Types and File Suffixes

text/plain	txt sh c ...	text/html	html htm
application/pdf	pdf	application/msword	doc, docx
image/jpeg	jpeg jpg jpe	audio/basic	au snd
audio/mpeg	mpga mp2 mp3	application/x-gzip	gz tgz
application/zip	zip	audio/ogg	oga, ogg, spx
video/ogg	ogv	video/webm	webm

37

HTML and HTML5

- HTML (the Hypertext Markup Language) is used to structure webpage contents.
- Since 1989, HTML has been constantly evolving and maturing. Today, the Web is moving toward HTML5, the next-generation HTML standard, which brings many new features and APIs (application programming interfaces).
- A document written in HTML contains ordinary text interspersed with *markup tags* and uses the `.html` filename extension.

37

38

Some HTML Tags

Entire page	`<html>...</html>`
Paragraph Meta	`<p>...</p>`
data	`<head>...</head>`
Unnumbered list	`<ul>...</ul>`
Page title	`<title>...</title>`
Numbered list	`<ol>...</ol>`
Page content	`<body>...</body>`
List item	`<li>...</li>`
Level *n* heading	`<hn>...</hn>`
Comment	`<!--...-->`

38

39

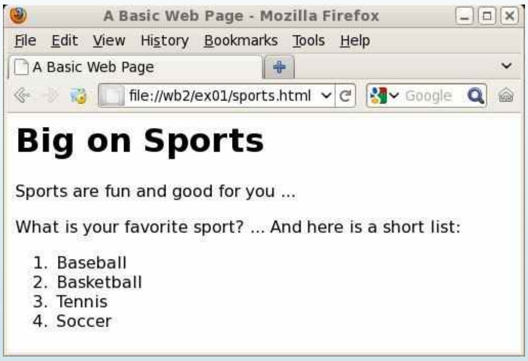
Ex: Sports

```
<!doctype html>
<html xmlns="http://www.w3.org/1999/xhtml" lang="en" xml:lang="en">
<meta charset="UTF-8"/>
<head> <title>A Basic Webpage</title> </head>
<body><section>
   <h1>Big on Sports</h1>
   <p>Sports are fun and good for you ...</p>
   <p> What is your favorite sport? ... And here is a short list:
   </p>
   <ol>
     <li> Baseball </li> <li> Basketball </li>
     <li> Tennis </li> <li> Soccer </li>
   </ol></section></body></html>
```

39

40

A Sample Webpage


A Basic Web Page - Mozilla Firefox
File Edit View History Bookmarks Tools Help
A Basic Web Page
file://wb2/ex01/sports.html
Google

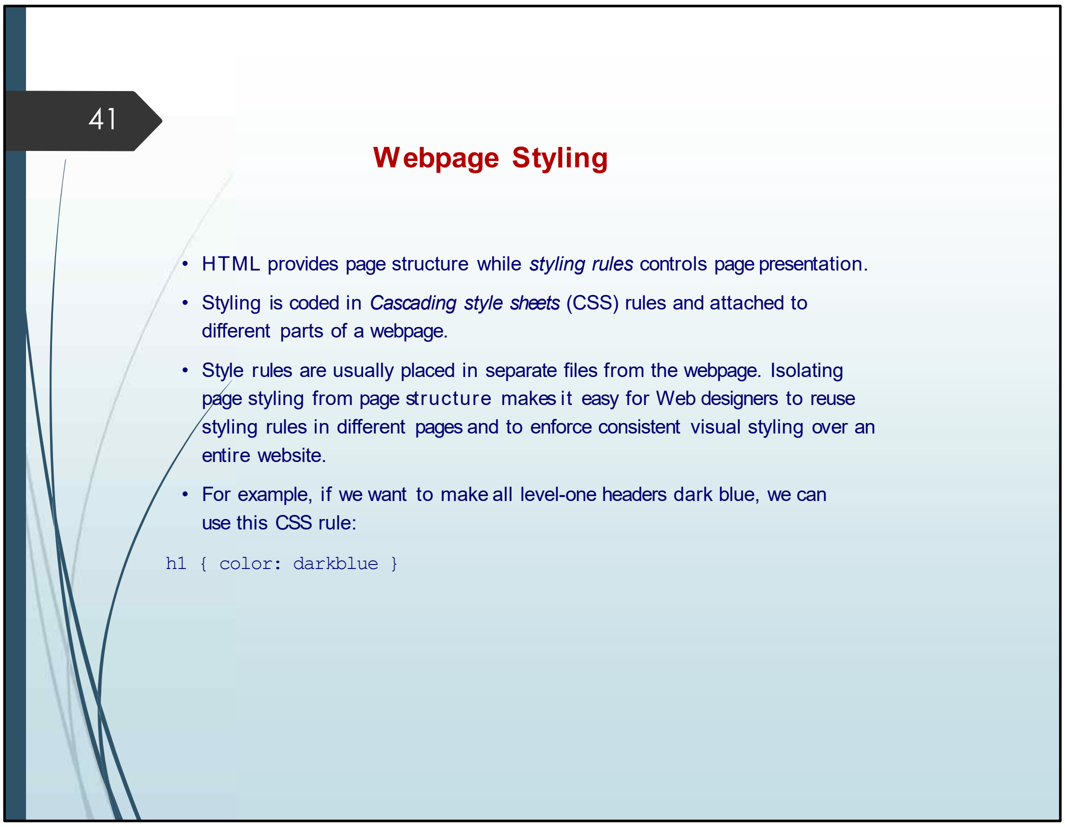
Big on Sports

Sports are fun and good for you ...

What is your favorite sport? ... And here is a short list:

1. Baseball
2. Basketball
3. Tennis
4. Soccer

40



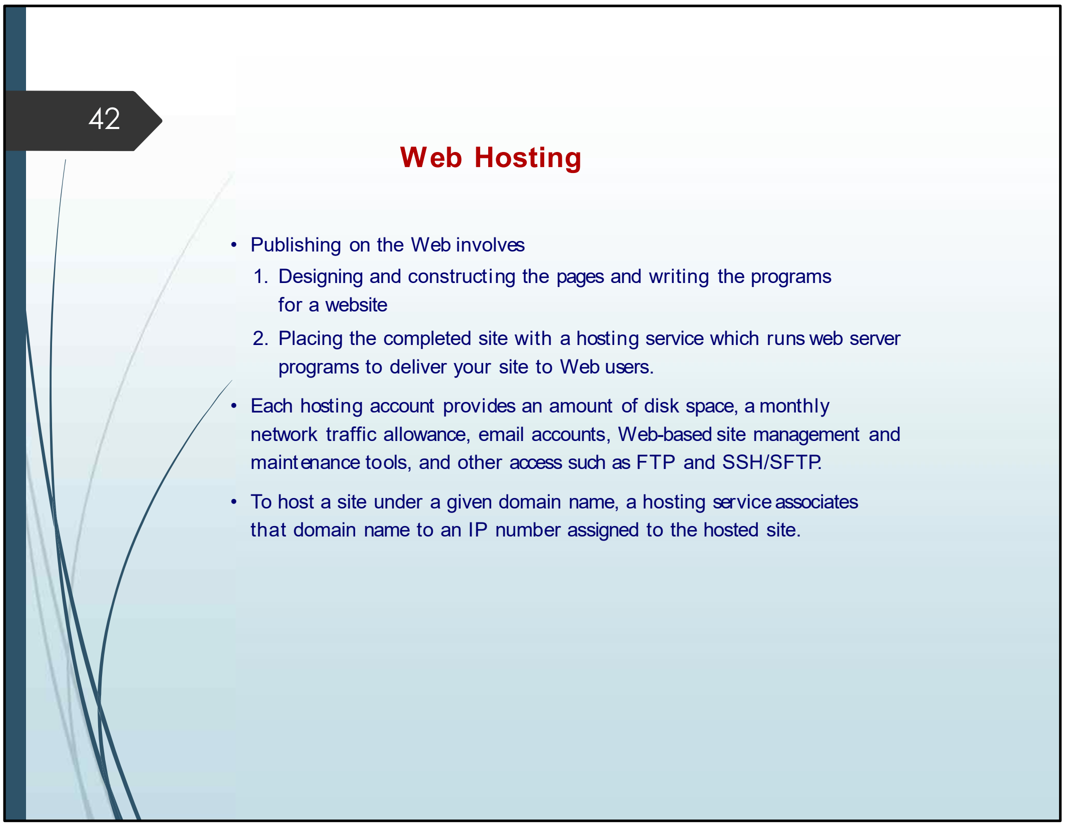
41

Webpage Styling

- HTML provides page structure while *styling rules* controls page presentation.
- Styling is coded in *Cascading style sheets* (CSS) rules and attached to different parts of a webpage.
- Style rules are usually placed in separate files from the webpage. Isolating page styling from page structure makes it easy for Web designers to reuse styling rules in different pages and to enforce consistent visual styling over an entire website.
- For example, if we want to make all level-one headers dark blue, we can use this CSS rule:

```
h1 { color: darkblue }
```

41

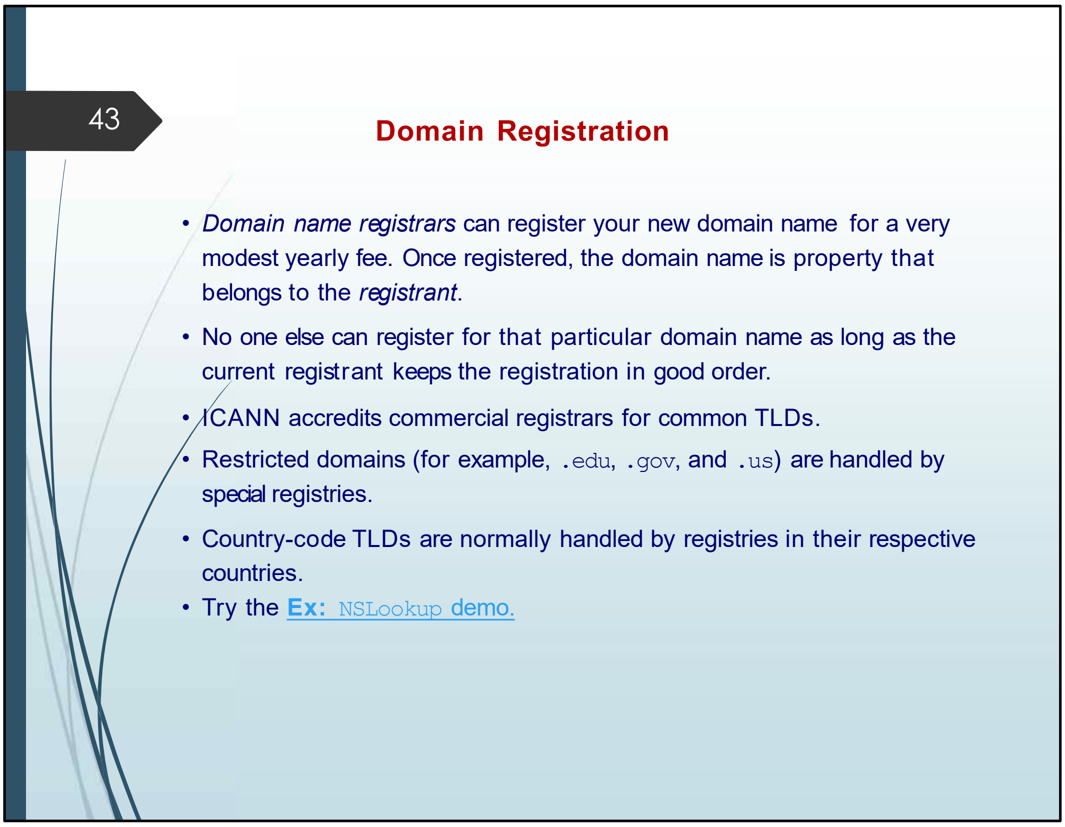


42

Web Hosting

- Publishing on the Web involves
  1. Designing and constructing the pages and writing the programs for a website
  2. Placing the completed site with a hosting service which runs web server programs to deliver your site to Web users.
- Each hosting account provides an amount of disk space, a monthly network traffic allowance, email accounts, Web-based site management and maintenance tools, and other access such as FTP and SSH/SFTP.
- To host a site under a given domain name, a hosting service associates that domain name to an IP number assigned to the hosted site.

42

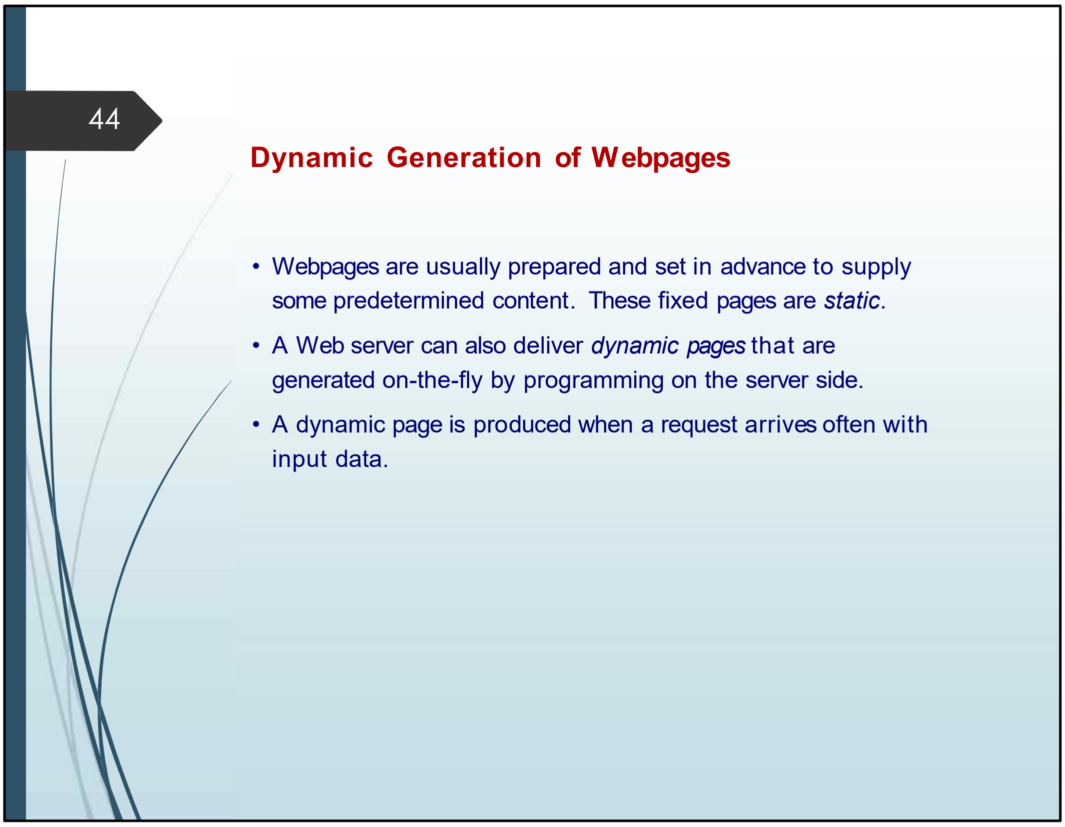


43

Domain Registration

- *Domain name registrars* can register your new domain name for a very modest yearly fee. Once registered, the domain name is property that belongs to the *registrant*.
- No one else can register for that particular domain name as long as the current registrant keeps the registration in good order.
- ICANN accredits commercial registrars for common TLDs.
- Restricted domains (for example, `.edu`, `.gov`, and `.us`) are handled by special registries.
- Country-code TLDs are normally handled by registries in their respective countries.
- Try the **Ex:** `NSLookup` demo.

43

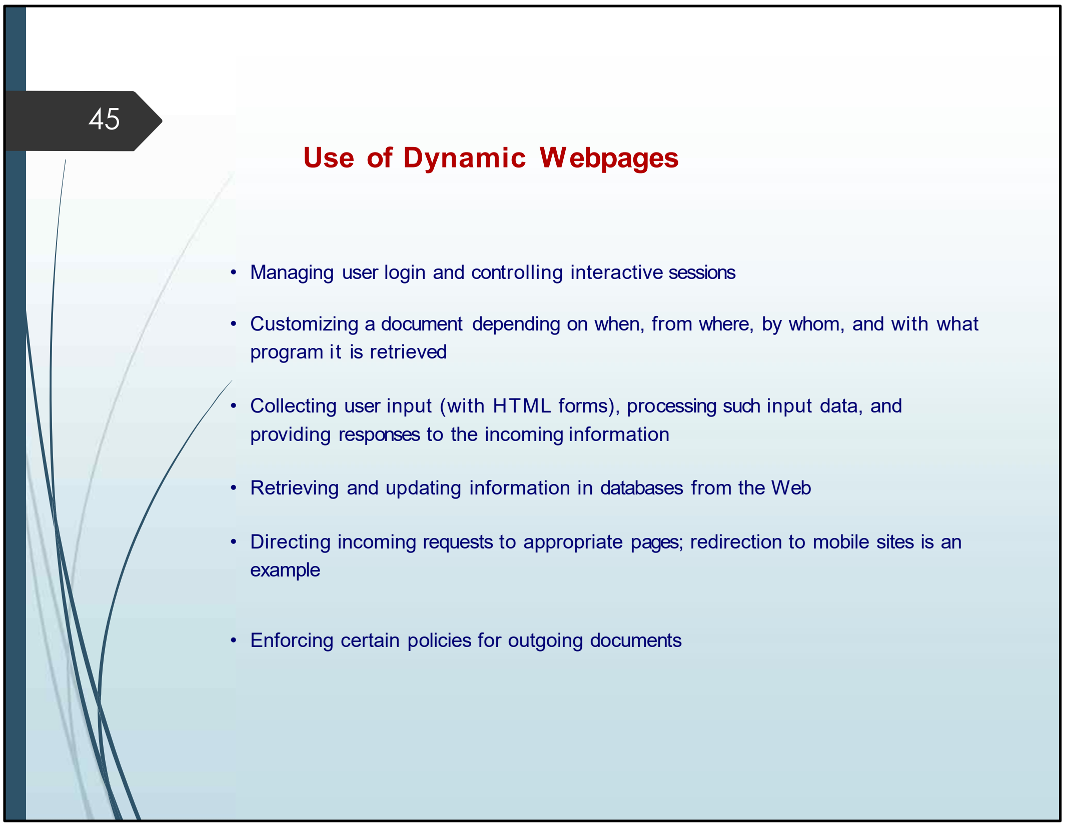


44

Dynamic Generation of Webpages

- Webpages are usually prepared and set in advance to supply some predetermined content. These fixed pages are *static*.
- A Web server can also deliver *dynamic pages* that are generated on-the-fly by programming on the server side.
- A dynamic page is produced when a request arrives often with input data.

44

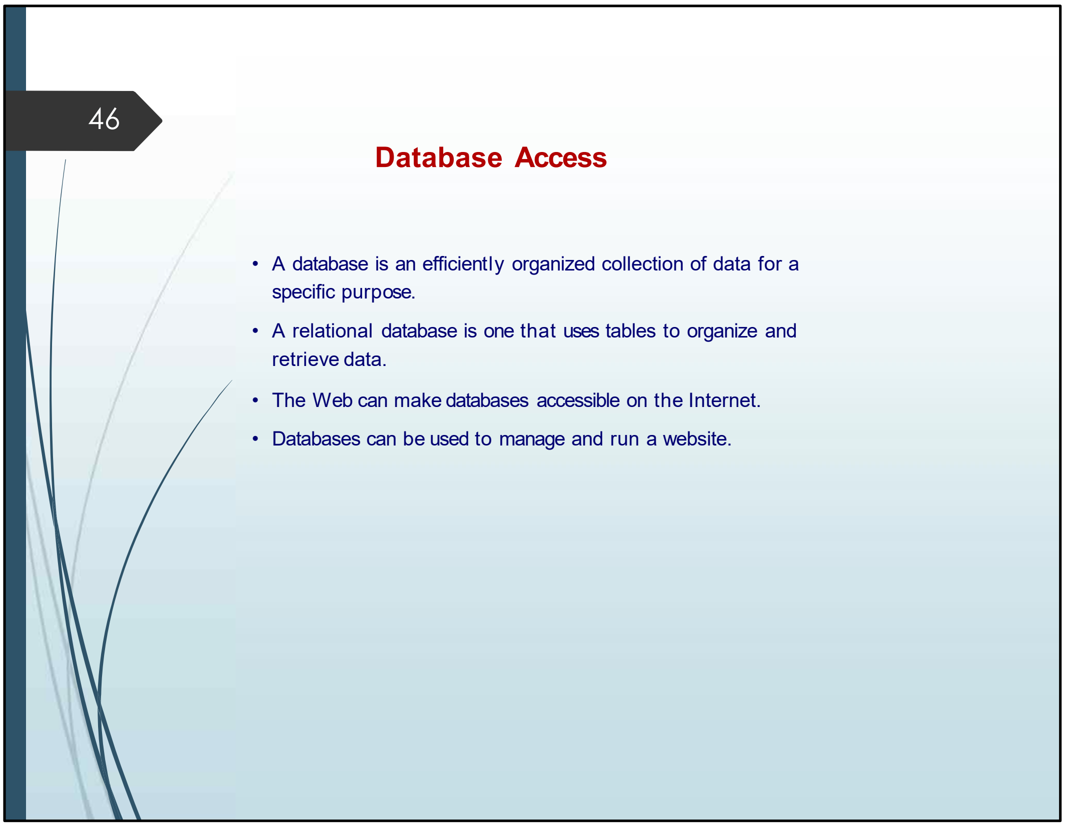


45

Use of Dynamic Webpages

- Managing user login and controlling interactive sessions
- Customizing a document depending on when, from where, by whom, and with what program it is retrieved
- Collecting user input (with HTML forms), processing such input data, and providing responses to the incoming information
- Retrieving and updating information in databases from the Web
- Directing incoming requests to appropriate pages; redirection to mobile sites is an example
- Enforcing certain policies for outgoing documents

45

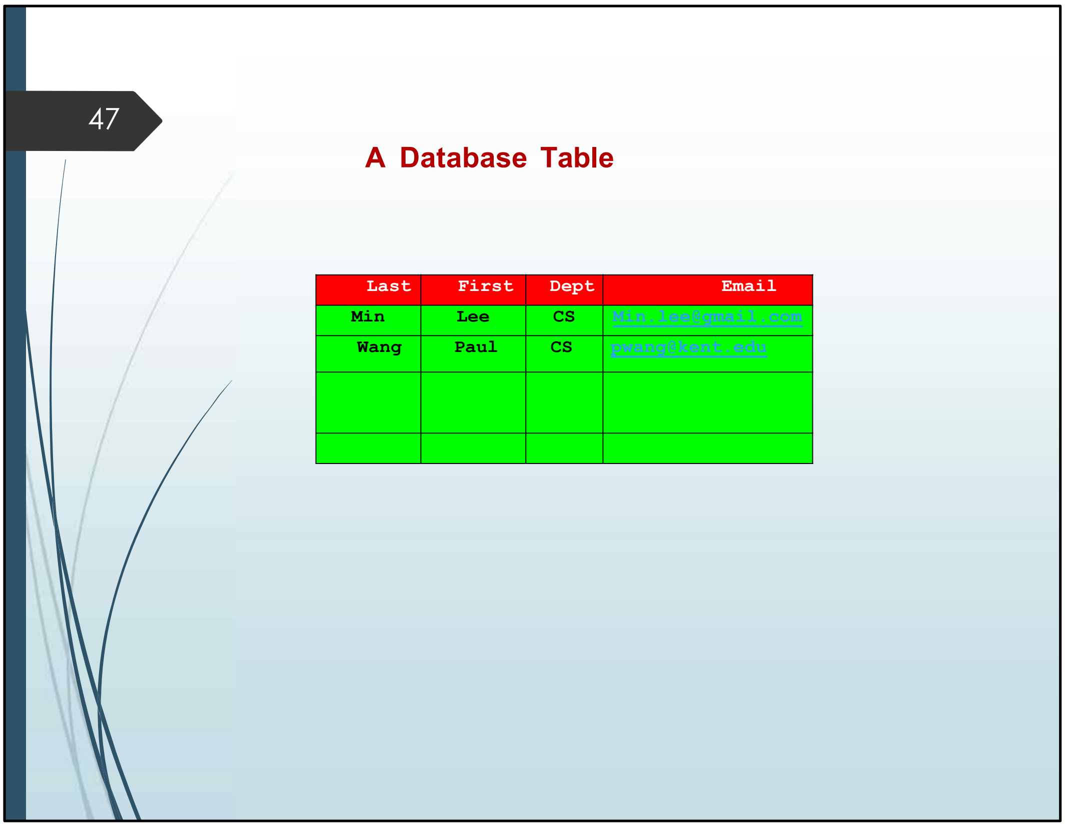


46

Database Access

- A database is an efficiently organized collection of data for a specific purpose.
- A relational database is one that uses tables to organize and retrieve data.
- The Web can make databases accessible on the Internet.
- Databases can be used to manage and run a website.

46

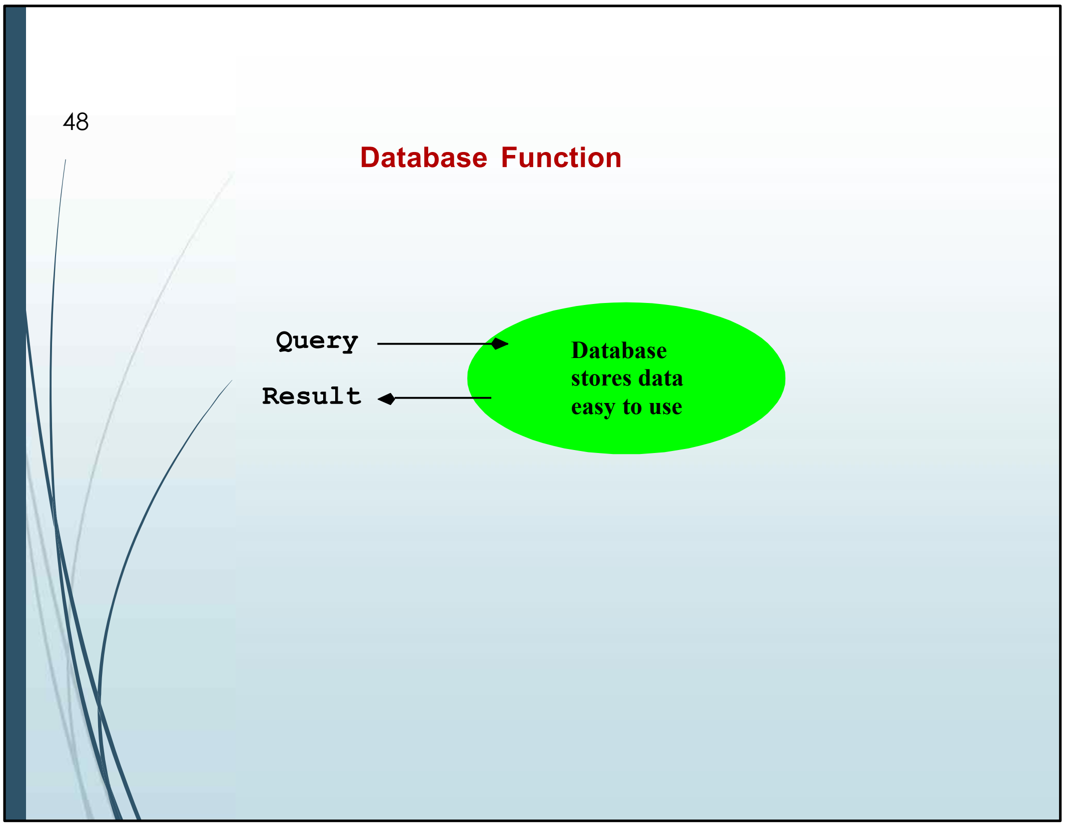


47

A Database Table

Last	First	Dept	Email
Min	Lee	CS	Min.lee@gmail.com
Wang	Paul	CS	pwang@kent.edu

47



48

Database Function

Query

Result

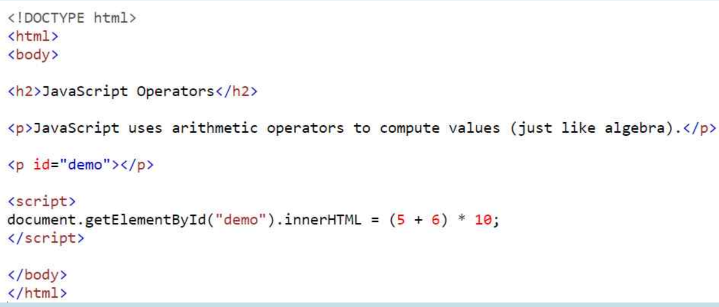
Database
stores data
easy to use

48

49

Client-Side Scripting

- The actions of a Web browser can be defined and controlled by programming within a webpage. Such programming can supply customized user experiences and make webpages more responsive and useful for end users.
- The programs execute within the browser, which runs on the client host, the computer used to access the Web.
- For all major browsers, *JavaScript* is the standardized scripting language for client-side programming.
- Because the JavaScript language standard has been developed and maintained by the *ECMA* (European Computer Manufacturer Association), the language is also known as *ECMAScript* (`ecma-international.org`).



```
<!DOCTYPE html>
<html>
<body>

<h2>JavaScript Operators</h2>

<p>JavaScript uses arithmetic operators to compute values (just like algebra).</p>

<p id="demo"></p>

<script>
document.getElementById("demo").innerHTML = (5 + 6) * 10;
</script>

</body>
</html>
```

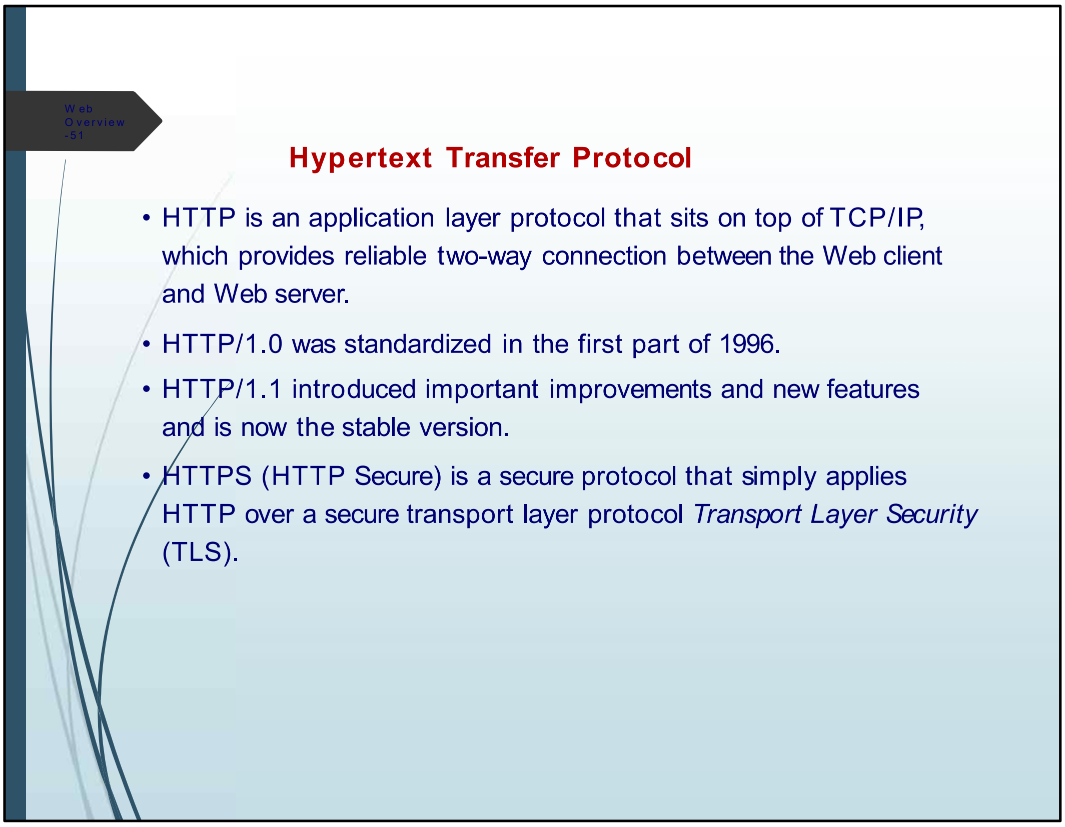
49

50

Document Object Model

- The *Document Object Model* (DOM) is an application programming interface (API) definition specifying how a document processing program such as a Web browser represents a document as a tree-structured object (the DOM tree) and allows programmatic access and manipulation of the DOM tree.
- All major browsers provide DOM support, including HTML, XHTML, HTML5, and XML DOM interfaces. Because JavaScript is the standard, it is not surprising that major browsers all implement the required DOM interfaces in JavaScript.
- Combine JavaScript with DOM and CSS and you have a technique, known as *DHTML*, to make webpages responsive and dynamic.

50

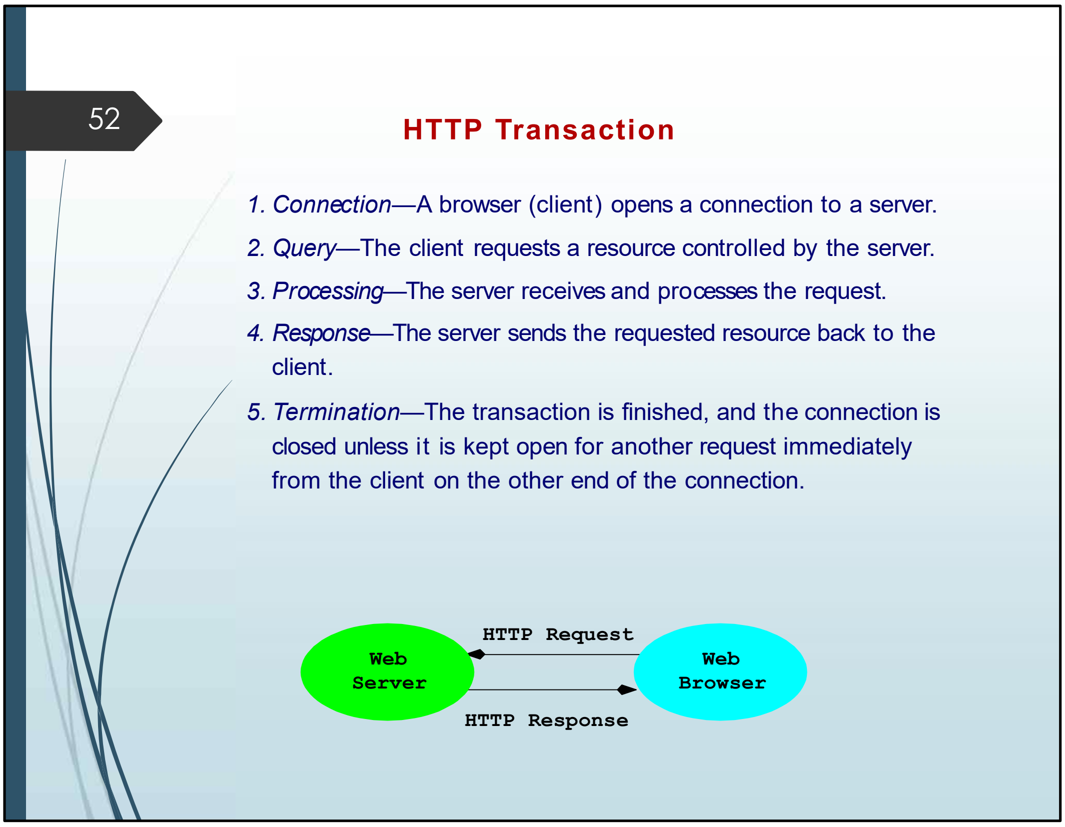


Web Overview -51

Hypertext Transfer Protocol

- HTTP is an application layer protocol that sits on top of TCP/IP, which provides reliable two-way connection between the Web client and Web server.
- HTTP/1.0 was standardized in the first part of 1996.
- HTTP/1.1 introduced important improvements and new features and is now the stable version.
- HTTPS (HTTP Secure) is a secure protocol that simply applies HTTP over a secure transport layer protocol *Transport Layer Security* (TLS).

51

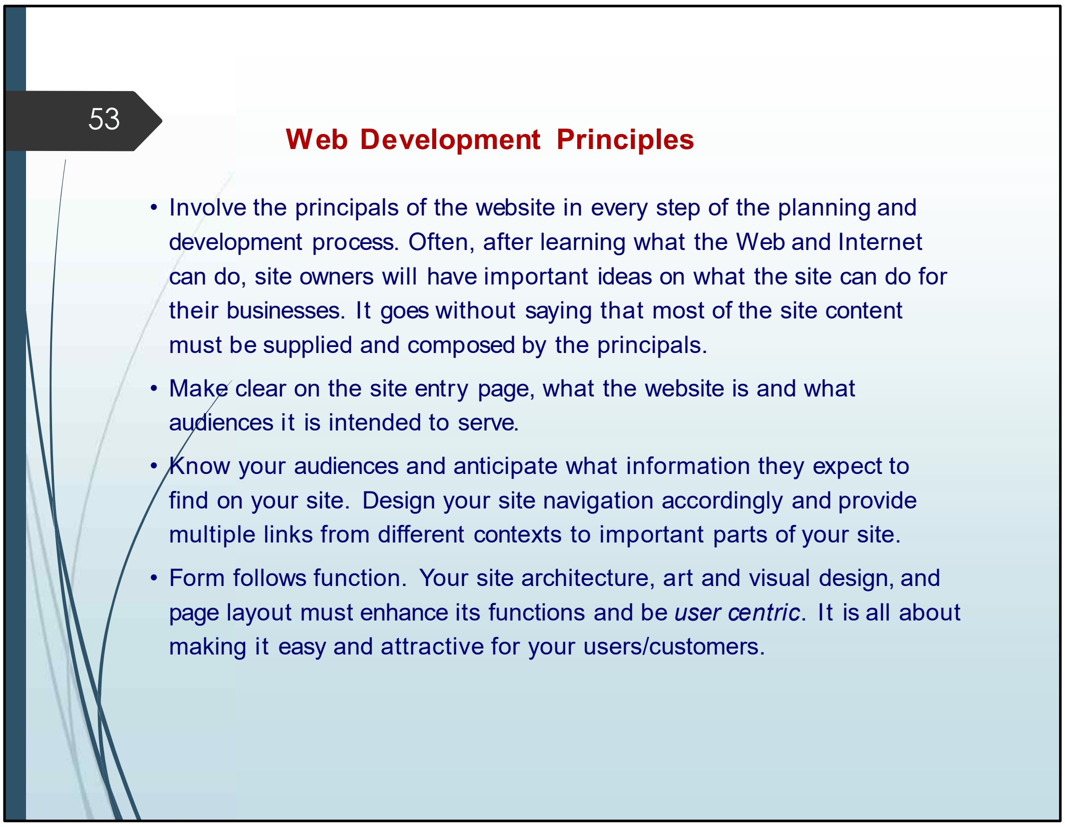


52

HTTP Transaction

1. *Connection*—A browser (client) opens a connection to a server.
2. *Query*—The client requests a resource controlled by the server.
3. *Processing*—The server receives and processes the request.
4. *Response*—The server sends the requested resource back to the client.
5. *Termination*—The transaction is finished, and the connection is closed unless it is kept open for another request immediately from the client on the other end of the connection.

52

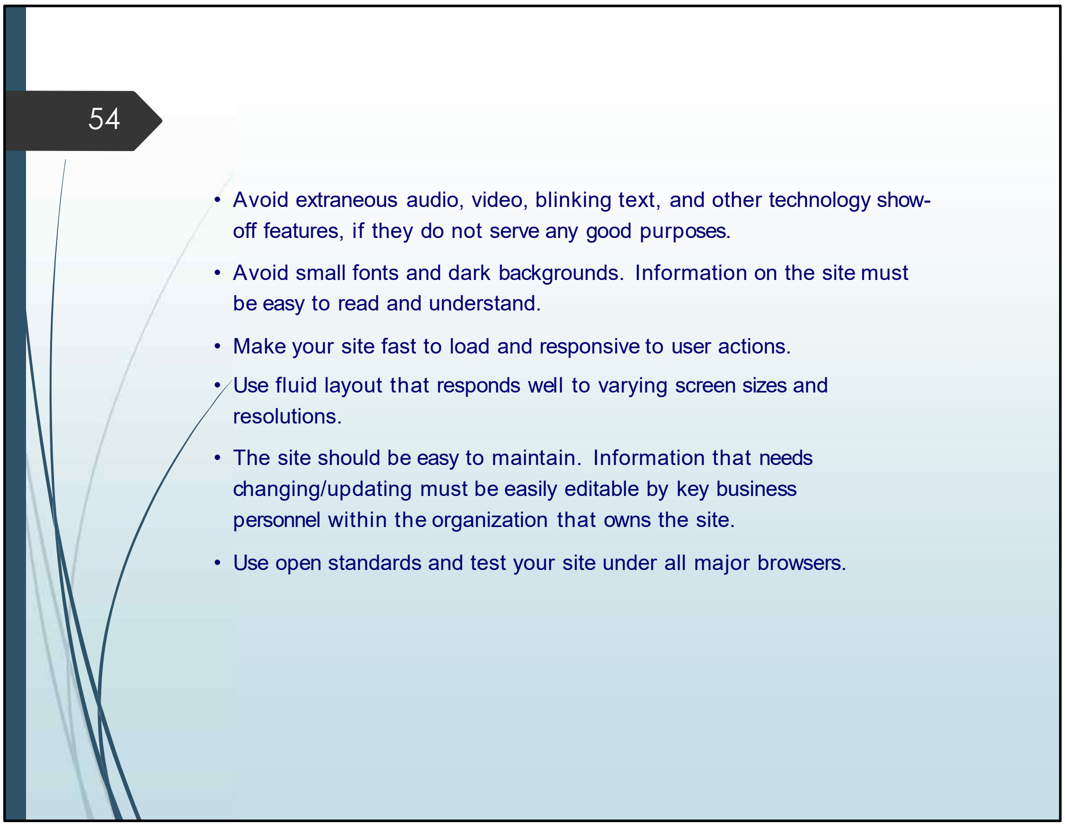


53

Web Development Principles

- Involve the principals of the website in every step of the planning and development process. Often, after learning what the Web and Internet can do, site owners will have important ideas on what the site can do for their businesses. It goes without saying that most of the site content must be supplied and composed by the principals.
- Make clear on the site entry page, what the website is and what audiences it is intended to serve.
- Know your audiences and anticipate what information they expect to find on your site. Design your site navigation accordingly and provide multiple links from different contexts to important parts of your site.
- Form follows function. Your site architecture, art and visual design, and page layout must enhance its functions and be *user centric*. It is all about making it easy and attractive for your users/customers.

53



54

- Avoid extraneous audio, video, blinking text, and other technology show-off features, if they do not serve any good purposes.
- Avoid small fonts and dark backgrounds. Information on the site must be easy to read and understand.
- Make your site fast to load and responsive to user actions.
- Use fluid layout that responds well to varying screen sizes and resolutions.
- The site should be easy to maintain. Information that needs changing/updating must be easily editable by key business personnel within the organization that owns the site.
- Use open standards and test your site under all major browsers.

54

55

Web Development Process

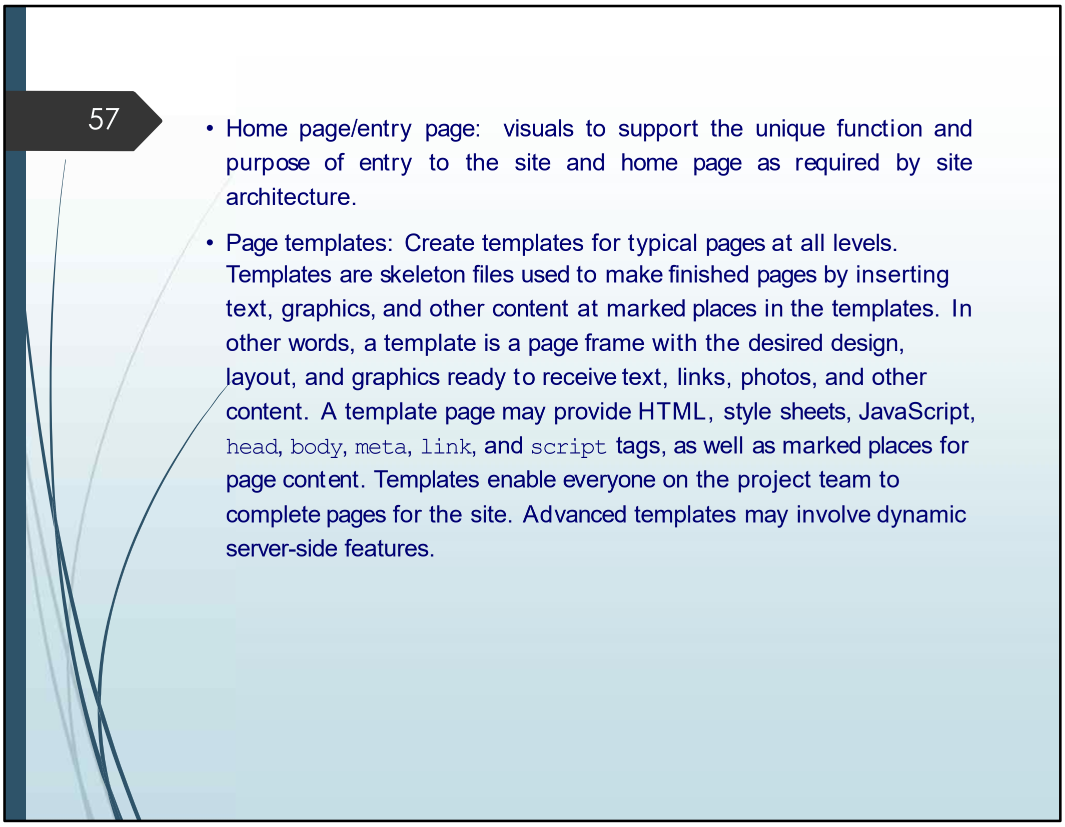
- Content: Create a content list or inventory; prepare content files ready to be included in webpages.
- Site map: Draw a relationship diagram of all pages to be created for the site, give each page appropriate titles, show page groupings and on-site and off-site links, distinguish static from dynamic pages, identify forms and server-side support. Major subsections of the site can have their own submaps.
- Skeletal site: Conceive an entry page, home page, typical subpages and sub-subpages, textual contents (can be in summary form), HTML forms with textual layout and descriptions of server-side support, structure of the file hierarchy for the site, and well-defined HTML coding standards for pages.

55

56

- Navigation: Follow the site architecture and site map to link the pages, use textual navigation links with rough placements (top, left, right, or bottom), avoid dead-end pages, and avoid confusing the user.
- Design concepts: features, characteristics, and look-and-feel of the site; the design must reflect client identity and site purpose.
- Storyboards: simple layout sketches based on content-only site for typical pages, HTML forms, and HTML form response pages; header, footer, margins, navigation bar, logo, and other graphical elements to support the delivery of content; client feedback and approval of storyboards.
- Page layout (for pages at all levels): content hierarchy and grouping; grids, alignments, constants, and variables on the page; placement and size of charts, graphs, illustrations, and photos; creative use of space and variations of font, grid, and color; style options and variations.

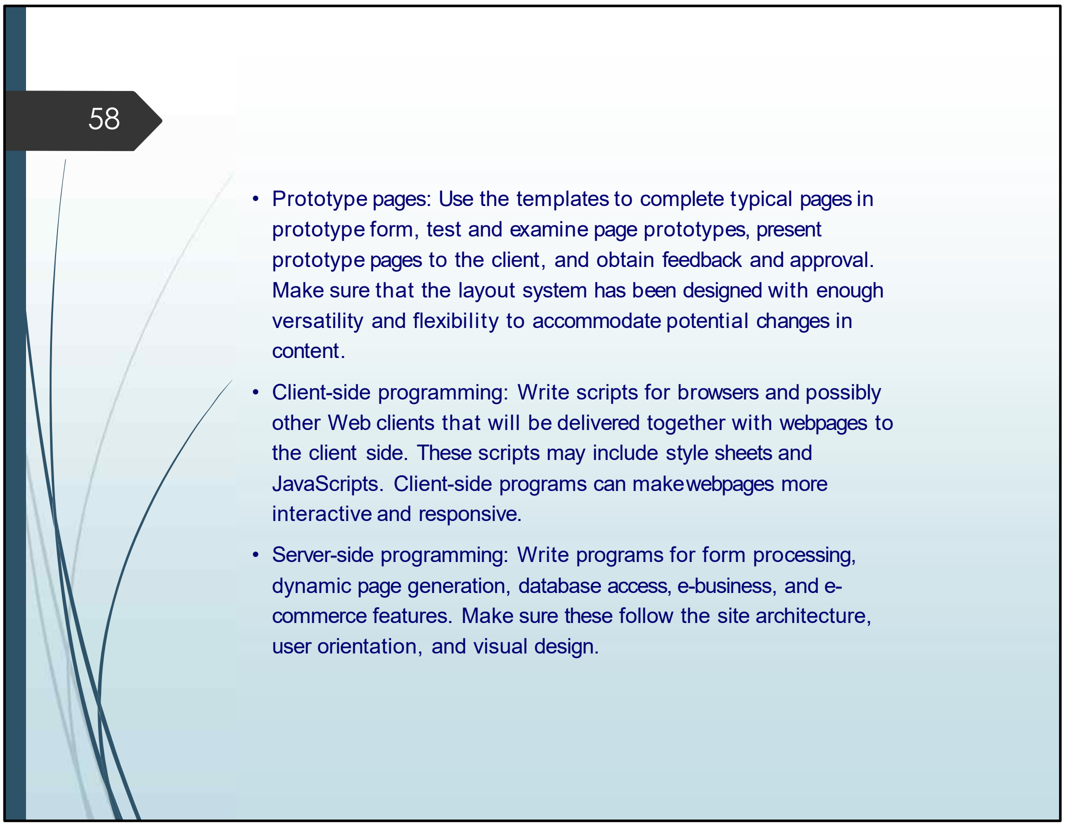
56



57

- Home page/entry page: visuals to support the unique function and purpose of entry to the site and home page as required by site architecture.
- Page templates: Create templates for typical pages at all levels. Templates are skeleton files used to make finished pages by inserting text, graphics, and other content at marked places in the templates. In other words, a template is a page frame with the desired design, layout, and graphics ready to receive text, links, photos, and other content. A template page may provide HTML, style sheets, JavaScript, `head`, `body`, `meta`, `link`, and `script` tags, as well as marked places for page content. Templates enable everyone on the project team to complete pages for the site. Advanced templates may involve dynamic server-side features.

57



58

- Prototype pages: Use the templates to complete typical pages in prototype form, test and examine page prototypes, present prototype pages to the client, and obtain feedback and approval. Make sure that the layout system has been designed with enough versatility and flexibility to accommodate potential changes in content.
- Client-side programming: Write scripts for browsers and possibly other Web clients that will be delivered together with webpages to the client side. These scripts may include style sheets and JavaScripts. Client-side programs can makewebpages more interactive and responsive.
- Server-side programming: Write programs for form processing, dynamic page generation, database access, e-business, and e-commerce features. Make sure these follow the site architecture, user orientation, and visual design.

58

59

59