CIS 3223 Homework 5

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Name:	Soln s

Temple ID (last 4 digits:

Simple non-graphing calculator	**Make:**

1 (8 pts). Consider the following 4 digit numbers

$x = 2872$ and $y = 6733$.

Compute the product xy using your calculator.

$\boxed{19337176}$

Find 2 digit numbers x_1, x_2, y_1 and y_2 such that

$2872 = x_1 \cdot 10^2 + x_2$ and $6733 = y_1 \cdot 10^2 + y_2$

x_1 $\boxed{28}$ x_2 $\boxed{72}$ y_1 $\boxed{67}$ y_2 $\boxed{33}$

Compute the following (use calculator for multiplication):

① $A = x_1 y_1 \quad = 28 \times 67$ $\boxed{1876}$

② $B = x_2 y_2 \quad = 72 \times 33$ $\boxed{2376}$

③ $C = (x_1 + x_2)(y_1 + y_2) = (28 + 72)(67 + 33) = 100^2$ $\boxed{10000}$

$D = C - A - B = 10000 - 1876 - 2376$ $\boxed{5748}$

$E = A \cdot 10^4 + D \cdot 10^2 + B$ $\boxed{19337176}$

$= 1876 \times 10^4 + 5748 \times 10^2 + 2376$

$= 18760000 + 574800 + 2376$

Number of

multiplications $\boxed{3}$

shifts by 10 $\boxed{6}$

additions and subtractions $\boxed{6}$

Compare E with xy.

2 (16 pts) Perform a dfs on the following undirected graph $G = (V, E)$ starting at vertex A; use the ordering given in the adjacency list representing E.

**Push neighbors onto the stack in reverse order.**

$V = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

$E\{1\} = [2, 7]$
$E\{2\} = [2, 3, 4]$
$E\{3\} = [2, 4]$
$E\{4\} = [2, 3]$
$E\{5\} = [6, 8]$
$E\{6\} = [5, 7]$
$E\{7\} = [1, 6]$
$E\{8\} = [5, 9, 10]$
$E\{9\} = [8, 10]$
$E\{10\} = [8, 9]$

parent	stack	pre	post	tree
9	~~10~~	~~13~~ 14	9-10
8	9	12 15	8-9
8	~~10~~		
5	~~9~~	11 16	5-8
6	5	10 17	6-5
7	~~6~~	9 18	7-6
3	~~4~~	4 5	3-4
2	~~3~~	3 6	2-3
2	~~4~~		
1	~~2~~	2 7	1-2
↓	~~7~~ 8	19	1-7
1	~~1~~	1 20	root

parent   stack   pre   post   tree

parent	1	1	2	3	6	7	1	5	8	9
pre	1	2	3	4	10	9	8	11	12	13
post	20	7	6	5	17	18	19	16	15	14
vertex	1	2	3	4	5	6	7	8	9	10

Draw the resulting spanning tree of G (horizontally). Add pre/post numbers.
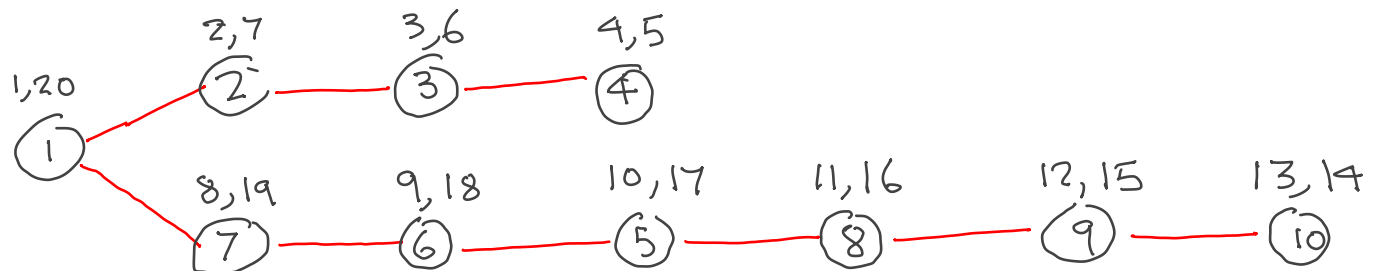
3 (16 pts) Perform a dfs on the following digraph $G = (V, E)$; whenever there is a choice of vertices, pick the one that is alphabetically first (so start with vertex a).

$V = \{$a̸, b̸, c̸, d̸, e, f, g̸, h̸$\}$

Adjacency list E :

$E\{a\} = [b, d]$
$E\{b\} = [c]$
$E\{c\} = [a]$
$E\{d\} = [c, g]$
$E\{e\} = [a, f, h]$
$E\{f\} = [g]$
$E\{g\} = [c, h]$
$E\{h\} = []$

Data:

Parent	a	a	b	a	e	e	d	g
Pre	1	2	3	6	13	14	7	8
Post	12	5	4	11	16	15	10	9
Vertex	a	b	c	d	e	f	g	h

Non-tree edges	Parent	Stack	Pre	Post	Tree edges
f-g		c	f	14 15	e- f
e-a, e-h		e	e	13 16	g-h
		g	h	8 9	g-h
g-c		d	g	7 10	d-g
c-a		b	c	3 4	b-c
		a	b	2 5	a-b
d-c		a	d	6 11	a-d
	a	a	1 12	root

Non-tree edge analysis

d-c	(11,16) (3,4)	cross
c-a	(3,4) (1,16)	back
g-c	(7,10) (3,4)	cross

Non-tree edge analysis

e-a	(13,16)(1,12)	cross
e-h	(13,16)(8,9)	cross
f-g	(14,15) (7,10)	cross

Draw a spanning tree (horizontally, red) and include pre/post numbers and back edges (black).
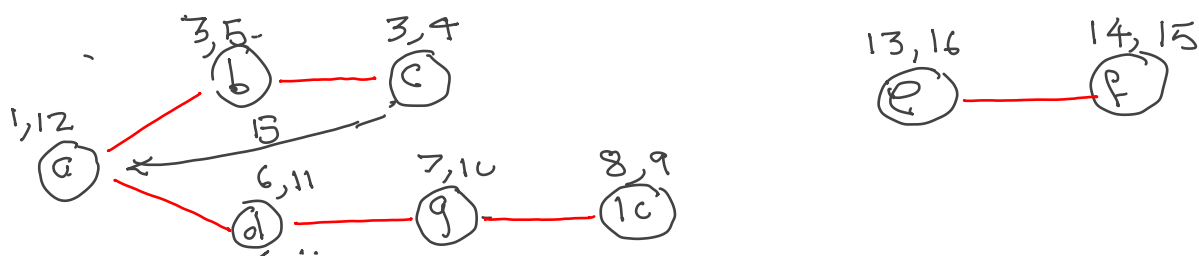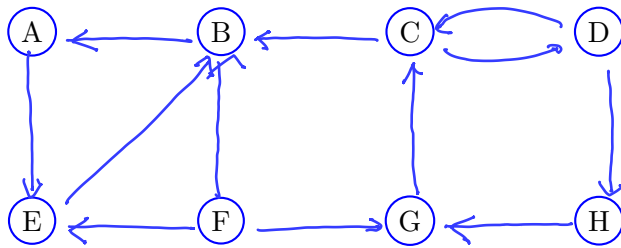
4 (10 pts) Consider the following directed graph G.

$$[1, 16] \qquad [2, 15] \qquad [3, 12] \qquad [4, 5]$$

A → B → C ⇄ D

$$[13, 14] \qquad [7, 8] \qquad [6, 11] \qquad [9, 10]$$
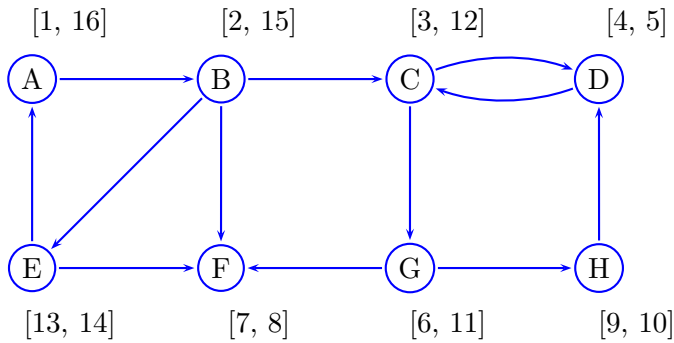
List the vertices in descending post order: $V_1 = \{$ ~~A, B, E~~, C, G, H, F, D $\}$

Perform a **dfs** on $G^R = (V_1, E^R)$, where G^R is the reverse graph of G.

Parent	Stack	Visited
F	F	F
H	G	C D H G
D	H	C D, H
C	D	C D
C	C	C
E	B	A, E, B
A	E	A, E
A	A	A

Complete the following array.

Parent	A	E	C	C	A	F	H	D
Vertex	A	B	C	D	E	F	G	H

List the strongly connected components: $\{A, B, E\}$, $\{C, D, G, H\}$, $\{F\}$

Draw the meta-graph where the nodes are the strongly connected components of G and there is an edge between two nodes if there is a vertex in first component connected to a vertex in the second component.