CS 173, Fall 2015
Examlet 13, Part A

NETID:

FIRST: **LAST:**

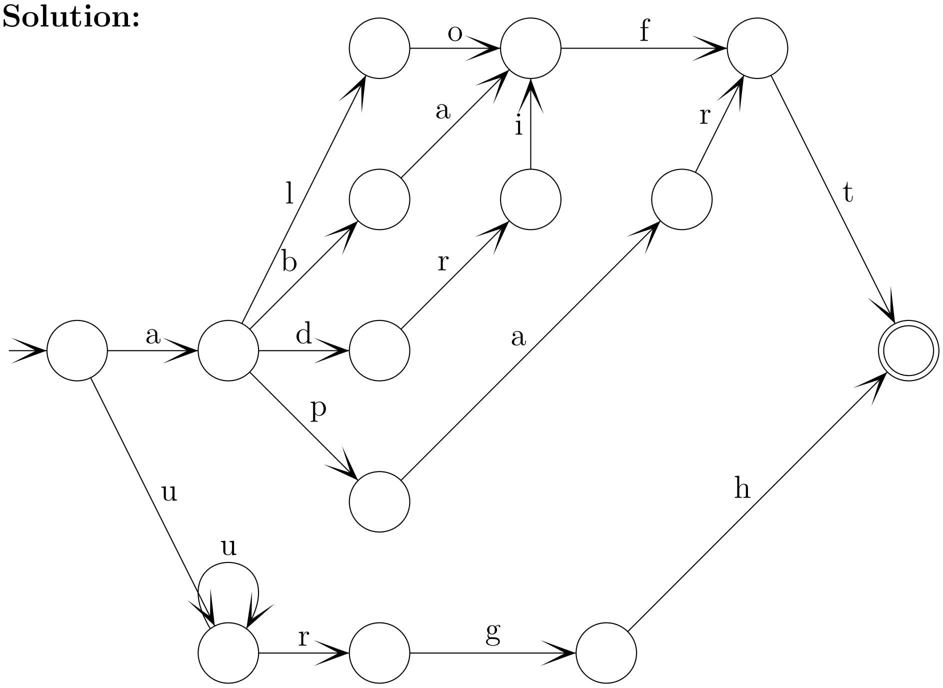
Discussion: Thursday 2 3 4 5 Friday 9 10 11 12 1 2

(15 points) Recall that a phone lattice is a state diagram representing sequences of letters. Each edge in a phone lattice has a single letter on it. In a "deterministic" state diagram, if you look at any state s and any letter a, there is never more than one edge labelled a leaving state s.

Draw a deterministic phone lattice representing exactly the following set of words, using no more than 17 states and, if you can, no more than 15.

aloft, abaft, adrift, apart
urgh, uurgh, uuurgh, ... [i.e. one or more u's at start of word]

Solution:



CS 173, Fall 2015
Examlet 13, Part B

NETID:

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(5 points) An RGB ring is a 3-cycle, each of whose nodes contains a color label (red, green, or blue) plus a real value in the range $[0, 1]$. Is the set of all RGB rings countable or uncountable? Briefly justify your answer.

Solution: This set is not countable. Representing an RGB ring requires a triple of values from $[0, 1]$. The interval $[0, 1]$ is uncountable, so a triple of values from this interval is also uncountable.

(10 points) Check the (single) box that best characterizes each item.

Any function from $\mathbb{N}$ to $\{0, 1\}$ has a corresponding C++ program that computes it. true ☐ false ☑ $\surd$ not known ☐

Suppose A is a non-empty set. Then $\mathbb{P}(A)$ is larger than A. true ☑ $\surd$ false ☐ true for finite sets ☐

The set of all (finite, unlabelled) graphs, where isomorphic graphs are treated as the same object. finite ☐ countably infinite ☑ $\surd$ uncountable ☐

The complex numbers finite ☐ countably infinite ☐ uncountable ☑ $\surd$

The set of board configurations for the game of chess. finite ☑ $\surd$ countably infinite ☐ uncountable ☐

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Review, Part A

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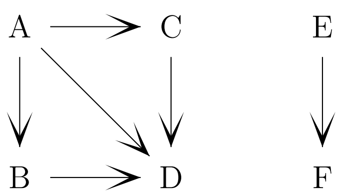
(5 points) Check all boxes that correctly characterize this relation on the set $\{A, B, C, D, E, F\}$.



Reflexive: ☐ Irreflexive: [√]

Symmetric: ☐ Antisymmetric: [√]

Transitive: [√]

(10 points) Check the (single) box that best characterizes each item.

$\sum_{k=3}^{n} k^7 =$ $\sum_{p=1}^{n-2} p^9$ ☐ $\sum_{p=1}^{n-2} k^7$ ☐ $\sum_{p=1}^{n-2} k^9$ ☐ $\sum_{p=1}^{n-2} (p+2)^7$ [√]

For any real number x, if $x > 10$, then $x^2 > 0$. true [√] false ☐ undefined ☐

$\emptyset$ is an element of $\mathbb{Z}$ ☐ a subset of $\mathbb{Z}$ [√] both ☐ neither ☐

Suppose a graph with 12 vertices is colored with exactly 5 colors. By the pigeonhole principle, every color appears on at least two vertices. true ☐ false [√]

$f : \mathbb{N} \to \mathbb{R}$, $f(x) = x^2 + 2$ onto ☐ not onto [√] not a function ☐

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Review, Part B

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(5 points) Is the cycle graph C_{17} a subgraph of the wheel graph W_{23}? Briefly justify your answer.

Solution: Yes, it is. Match 16 of the nodes in C_{17} with consecutive nodes on the rim of W_{23}. Then match the last node of C_{17} with the hub node of W_{23}.

(10 points) Check the (single) box that best characterizes each item.

The chromatic number of a graph with maximum vertex degree D

$= D$	☐	$= D+1$	☐
$\leq D+1$	☑ √	$\geq D+1$	☐

If $f : \mathbb{R} \to \mathbb{P}(\mathbb{Z})$ then $f(17)$ is

an integer	☐	a set of integers	☑ √
one or more integers	☐	a power set	☐

A full m-ary tree with i internal nodes has $mi + 1$ nodes total.

always	☑ √	sometimes	☐	never	☐

$n!$

$O(2^n)$	☐	$\Theta(2^n)$	☐	neither of these	☑ √

Problems in NP need exponential time

proven true	☐	proven false	☐	not known	☑ √