

Time: 50 min

P0	P1	P2	P3	P4	P5	Total
/1	/10	/7	/8	/10	/14	/50

**Problem 0: Student Information [1 mark]**

Name:

Student #:

Signature:

(Your signature indicates your agreement to the rules below. Note: you **must** agree to the rules to write the exam.)

***Rules Governing Formal Examinations***

1. Each candidate must be prepared to produce, upon request, a Library/AMS card for identification.
2. Candidates are not permitted to ask questions of the invigilators, except in cases of supposed errors or ambiguities in examination questions.
3. No candidate shall be permitted to enter the examination room after the expiration of one-half hour from the scheduled starting time, or to leave during the first half hour of the examination.
4. Candidates suspected of any of the following, or similar, dishonest practices shall be immediately dismissed from the examination and shall be liable to disciplinary action.
  - a. Having at the place of writing any books, papers or memoranda, calculators, computers, audio or video cassette players or other memory aid devices, other than those authorized by the examiners.
  - b. Speaking or communicating with other candidates.
  - c. Purposely exposing written papers to the view of other candidates. The plea of accident or forgetfulness shall not be received.
5. Candidates must not destroy or mutilate any examination material; must hand in all examination papers; and must not take any examination material from the examination room without permission of the invigilator.

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(except for this notice, of course)

### Problem 1: Definitions [10 marks]

Match the definitions on the right with the terms on the left by writing the appropriate letter in the blanks on the left. (Not every definition on the right will be used.)

- |                                  |   |
|----------------------------------|---|
| _____ Pixel                      | A. when each piece of a shape is geometrically similar to the whole   |
| _____ Self-similarity            | B. list of well-defined instructions for accomplishing some task  |
| _____ IP address                 | C. an image represented as a grid   |
| _____ Point-to-point network     | D. the smallest unit of data sent across a network  |
| _____ URL                        | E. a description of how data of one type (source data) can be represented using data of another type (encoded data) |
| _____ Broadcast network          | F. user interface problems are the result of users' mistakes  |
| _____ Data representation scheme | G. the address of a computer, in a computer-friendly format   |
| _____ Algorithm                  | H. a device that interprets instructions  |
| _____ Domain name                | I. the address of a computer, in a human-friendly format  |
| _____ Myth of human error        | J. the address of a web page  |
|                                  | K. a group of computers, some of which are connected to each other via direct links                                 |
|                                  | L. a group of computers, all of which are connected to each other by a single, shared link                          |
|                                  | M. a single "dot" of colour in a raster image   |

## Problem 2: HCI and Colours [7 marks]

A (hypothetical) professor recently experimented with her students. She gave an exam with the following question on it:

Translate the hexadecimal HTML colour first into a decimal (normal base 10) colour: **E060E0**.

One half of the students were given calculators that could convert a typed hexadecimal number into decimal at the push of a button. The other half were given this chart:

Hex	Decimal	Hex	Decimal	Hex	Decimal	Hex	Decimal
00	0	40	64	80	128	C0	196
10	16	50	80	90	144	D0	208
20	32	60	96	A0	160	E0	224
30	48	70	112	B0	176	F0	240

(a) Use your knowledge of HTML colours and the concept that “tools augment and constrain our power to think and act” to explain why many of the students with calculators got the *wrong* answer. (Their answer was the single number 14704864, but you need not justify the particular answer.)

(b) Use your knowledge of HTML colours to answer the instructor’s question: what is the decimal representation of the colour **E060E0**?

(c) Describe the colour **E060E0** in English (e.g., “dark green” or “bright white”).

### Problem 3: Artists and Images [8 marks]

Next to each of the following images, indicate each of the following by circling the appropriate answer:

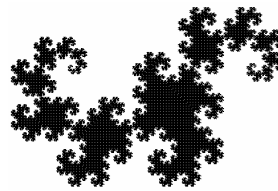
(a) Which **one** of the following three artists the image's style most closely resembles: Vera **Molnar**, Joan **Truckenbrod**, and Harold **Cohen**/Aaron, or indicate **none of these**. (Of the four images, one is in each of the artists' styles and one is in none of their styles. Note that **no image** by A. Michael Noll is included.)

(b) Whether the image would be best represented as a raster graphics image, a vector graphics image (without self-similarity), or using a self-similar representation.



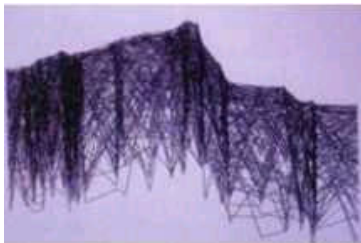
Artist:

Representation:



Artist:

Representation:



Artist:

Representation:



Artist:

Representation:

#### Problem 4: Algorithms [10 marks]

You are hired by a company that has invented teleportation. Each teleporter connects **one** location to **one** other location. The cost of a teleporter is proportional to the distance between the two ends of the connection. So, when you build a teleport network, you want to connect all cities (so there's a route to teleport along between any pair of cities), using the smallest, cheapest collection of teleporters. For example, the network on the right below is the cheapest one for the six cities on the left.



(a) Characterize this problem algorithmically.

INPUTS:

OUTPUTS:

CONSTRAINTS:

(b) Propose a way to solve this problem by transforming inputs to this problem into inputs to a TSP problem and transforming the TSP solution back into a solution for this problem. Hint: be careful not to build more links than you need to build!

[Note: you don't need all the space below for this. That's just how the page broke!]

### Problem 5: JavaScript, HTML, and Algorithms [14 marks]

Consider the following web page code for a guessing game:

```

1 <html><head><title>Don't Forget a Title!</title></head>
2 <body>
3 <script>
4 // Picks a random number between low and high (inclusive).
5 function random(low, high)
6 {
7     return Math.floor(Math.random() * (high - low + 1)) + low;
8 }
9
10 // Tries to find where target appears in the text.
11 // Returns -1 if the target cannot be found.
12 function locateTarget(text, target)
13 {
14     var start = 0;
15     while (start < text.length)
16     {
17         var end = start + target.length;
18         if (end <= text.length)
19         {
20             if (target == text.substring(start, end))
21             {
22                 return start;
23             }
24         }
25         start = start + 1;
26     }
27     return -1;
28 }
29
30 // Finds the target in the typed text.
31 function findTarget()
32 {
33     // Fetch the text and target from the blanks.
34     var text = document.getElementById("blank").value;
35     var target = document.getElementById("target").value;
36
37     // Find the location of target in text.
38     var result = locateTarget(text, target);
39
40     // Show it to the user.
41     alert("I found '" + target + "' at index " + result + ".");
42 }
43 </script>
44
45 <h1>Word Finding Game</h1>
46
47 Type a word in this blank: <input type="text" id="blank"> <br>
48 Type your target word in this blank: <input type="text" id="target">
49 <p>
50 <input type="button" value="Find the Target" onclick="findTarget()">
51
52 </body></html>

```



(a) Sketch what the page looks like when it loads.



(b) Imagine we put “Hello” in the first blank and “low” in the second blank and then clicked “Find the Target”. The program would execute line 18 several times. In the boxes below, fill in the values of the variables `text`, `target`, `start`, and `end` each time line 18 is executed. WARNING: there may be more boxes than you need! Just ignore the extra boxes. To get you started, we completed the first execution of line 18.

First time at line 18:

text	target	start	end
<b>Hello</b>	<b>low</b>	<b>0</b>	<b>3</b>

Next time at line 18:

text	target	start	end

Next time at line 18:

text	target	start	end

Next time at line 18:

text	target	start	end

Next time at line 18:

text	target	start	end

Next time at line 18:

text	target	start	end

Next time at line 18:

text	target	start	end

(c) What would this web page show if we put “Bat Phone” in the first blank and “hon” in the second blank and clicked the “Find the Target” button?

(d) What would this code show if we put “Bat Phone” in the first blank and “rings!” in the second blank and clicked the “Find the Target” button?

**EXTRA SPACE**

**(if you use this, CLEARLY indicate both the connection between this work and the problem it is for both here and where the problem is stated!)**

## Appendix A: HTML tags and JavaScript functions

Start Tag	End Tag	Meaning
<html>	</html>	surrounds whole HTML document
<title>	</title>	title bar text; describes page
<head>	</head>	preliminary material at start of the page
<body>	</body>	the main part of the page
<p>		Paragraph
<hr>		line (horizontal rule), can use width and size attributes
<h1> ... <h8>	</h1> ... </h8>	headings, eight levels, use in order, can use align attribute
<b>	</b>	Bold
<i>	</i>	Italic
<a href="fn">	</a>	anchor reference, <i>fn</i> must be a pathname to a file, e.g. html or pdf file
		image source reference, <i>fn</i> must be pathname to image file (e.g. .jpg or .gif)
<ol>	</ol>	ordered list
<ul>	</ul>	unordered list
<li>	</li>	list item
<table>	</table>	table, can use border attribute
<th>	</th>	table heading
<td>	</td>	table data
<input type="fn">		input field, <i>fn</i> must be an input type like button or text; can use attributes like value (for button text) and onclick (for button behaviour when clicked)
<!--	-->	HTML comment; ignored by the web browser. (Technically not a “tag”.)

## JavaScript Function reference

If *word* is a variable storing a string and *i* and *j* are variables storing integers, *word.substring(i, j)* evaluates to the letters in *word* starting at index *i* and going up to just before *j*. For example:

```
var word = "Testing";
var i = 3;
var j = 6;
alert(word.substring(i, j));
```

would show the message "tin".