Final Review: Questions
Which of the following is **not** one of the 7 big ideas of computing?

A. Abstraction is a way to understand and solve problems.

B. Digital devices, systems, and the networks that interconnect them enable and foster computational approaches to solving problems.

C. Data and information help to create knowledge.

D. Privacy is a fundamental right of humans.
• Which of the following is not one of the 7 big ideas of computing?

A. Abstraction is a way to understand and solve problems.

B. Digital devices, systems, and the networks that interconnect them enable and foster computational approaches to solving problems.

C. Data and information help to create knowledge.

D. Privacy is a fundamental right of humans.
Alice would like to donate a kidney to Bob, who needs one. But they are not a match.

Charlie would like to donate a kidney to Mallet, but they are not a match.

Alice realizes that she is a match for Mallet and that Charlie is a match for Bob, so she arranges a swap. She'll donate her kidney to Mallet if Charlie will donate his kidney to Bob.

• Is this an example of computational thinking?
   A. Yes, because it is looking at the problem from the point of view of optimizing operations to maximize efficiency.
   B. No, because there is no computer involved making the calculation.
Alice would like to donate a kidney to Bob, who needs one. But they are not a match.

Charlie would like to donate a kidney to Mallet, but they are not a match.

Alice realizes that she is a match for Mallet and that Charlie is a match for Bob, so she arranges a swap. She'll donate her kidney to Mallet if Charlie will donate his kidney to Bob.

- Is this an example of computational thinking?
  
  **A.** Yes, because it is looking at the problem from the point of view of optimizing operations to maximize efficiency.

  **B.** No, because there is no computer involved making the calculation.
• When was the peak in women's enrollment in computer science undergraduate programs?
A. 1980s
B. 1990s
C. 2001 before the dot-com crash
D. 2008 before the recession
E. It has been steadily increasing over time
• When was the peak in women's enrollment in computer science undergraduate programs?
  A. 1980s
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  D. 2008 before the recession
  E. It has been steadily increasing over time
In 1984 the hot gadgets were pocket calculators. In 2014 the hot gadgets are smartphones. Using Moore's law, about how many times more computing power do you expect today's smartphones to have compared to 1985 pocket calculators?

A. 10 times more powerful
B. 20 times more powerful
C. 30 times more powerful
D. 1,000 times more powerful
E. 1,000,000 times more powerful
In 1984 the hot gadgets were pocket calculators. In 2014 the hot gadgets are smartphones. Using Moore's law, about how many times more computing power do you expect today's smartphones to have compared to 1985 pocket calculators?

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D. 1,000 times more powerful
E. 1,000,000 times more powerful

Casio FX-7000G  422 bytes memory
iPhone 5c  one billion transistors
• Can you fit one copy of every book in the Library of Congress on a USB stick you buy for $5?

A. Yes
B. No
Can you fit one copy of every book in the Library of Congress on a USB stick you buy for $5?

A. Yes

B. No

Library of Congress: 10 terabytes
Cheap USB stick: 4 gigabytes
A. Step, Power, Left, Step, Step, Power, Right, Right, Jump, Jump, Step, Power
B. Step, Power, Right, Step, Step, Power, Left, Left, Jump, Jump, Step, Power
C. Step, Power, Left, Step, Step, Power, Left, Left, Jump, Jump, Jump, Power
D. Step, Power, Right, Step, Power, Left, Jump, Jump, Jump, Step, Power
A. Step, Power, Left, Step, Step, Power, Right, Right, Jump, Jump, Step, Power

B. Step, Power, Right, Step, Step, Power, Left, Left, Jump, Jump, Step, Power

C. Step, Power, Left, Step, Step, Power, Left, Left, Jump, Jump, Jump, Power

D. Step, Power, Right, Step, Power, Left, Jump, Jump, Jump, Step, Power
Is this a correct solution?
A. Yes
B. No
• Is this a correct solution?
  A. Yes
  B. No
Is it possible to build a computer using Lego bricks without using any motors or other electric parts?

A. No, without electric power it won't move and so can't do anything.

B. Yes, the presence or absence of a brick can indicate bits and levers and gears etc. can perform simple binary operations.
Is it possible to build a computer using Lego bricks without using any motors or other electric parts?

A. No, without electric power it won't move and so can't do anything.

B. Yes, the presence or absence of a brick can indicate bits and levers and gears etc. can perform simple binary operations.

Andrew Carol
What binary function is this artificial neuron computing?

A. OR
B. AND
C. NOT
D. NOR
E. NAND
What binary function is this artificial neuron computing?

A. OR
B. AND
C. NOT
D. NOR
E. NAND
Which company did the NSA target for surveillance according to the leaked Snowden documents?

A. Microsoft
B. Google
C. Facebook
D. Apple
E. All of the above
Which company did the NSA target for surveillance according to the leaked Snowden documents?

A. Microsoft  
B. Google  
C. Facebook  
D. Apple  
E. All of the above
True or false: the "Numa Numa guy" suffered severe psychological trauma from his embarrassing viral YouTube video.

A. True
B. False
True or false: the "Numa Numa guy" suffered severe psychological trauma from his embarrassing viral YouTube video.

A. True

B. False
• What is the biggest number you can represent using 5 binary bits?

A. 32
B. 16
C. 15
D. 31
E. 63
What is the biggest number you can represent using 5 binary bits?

A. 32
B. 16
C. 15
D. 31
E. 63

11111 = 16+8+4+2+1 = 31
• An old Western movie begins with a static desert scene showing a cactus. Over the first two minutes the audience hears a rider approaching but can only see the cactus.

Will this movie segment compress well?
A. Yes because it has spatial coherence.
B. Yes because it has temporal coherence.
C. No because video takes lots of bits for each frame.
An old Western movie begins with a static desert scene showing a cactus. Over the first two minutes the audience hears a rider approaching but can only see the cactus.

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C. No because video takes lots of bits for each frame.
Decode the compressed message

01100101010111

A. FDULLL
B. FUDLLL
C. FULDLLL
D. FDDFL
• Decode the compressed message

011001010111

A. FDULLL
B. FUDLLL
C. FULDLLL
D. FDDFL
A. Draws a white ball falling downwards off the screen
B. Draws a white ball falling downwards across the screen leaving a trail
C. Draws a white ball falling down until a point above the bottom, then it stops
D. Draws a white ball falling until it just hits the bottom border, then it stops
E. The program has an error and doesn't work.

```cpp
int balldiam = 20;
int ballx = 50;
int bally = -balldiam/2;

void setup() {
    size(100, 100);
}

void draw() {
    background(0);
    ellipse(ballx, bally,
            balldiam, balldiam);
    if(bally < 100-balldiam/2) {
        bally = bally+2;
    }
}  ```
A. Draws a white ball falling downwards off the screen
B. Draws a white ball falling downwards across the screen leaving a trail
C. Draws a white ball falling down until a point above the bottom, then it stops
D. Draws a white ball falling until it just hits the bottom border, then it stops
E. The program has an error and doesn't work.

```plaintext
int balldiam = 20;
int ballx = 50;
int bally = -balldiam/2;

void setup() {
    size(100, 100);
}

void draw() {
    background(0);
    ellipse(ballx, bally, balldiam, balldiam);
    if(bally < 100-balldiam/2) {
        bally = bally+2;
    }
}
```
• Why is pair programming attractive to businesses?
A. It's more fun to program with others
B. You can get help when you get stuck
C. Programming projects require teams and communication
D. Programming in pairs is more efficient
• Why is pair programming attractive to businesses?
  A. It's more fun to program with others
  B. You can get help when you get stuck
  C. Programming projects require teams and communication
  D. Programming in pairs is more efficient
• What color is 1/3 of the way from black to white?

A. color(0, 0, 0)
B. color(0.333, 0.333, 0.333)
C. color(0, 0.333, 0.666)
D. color(0.5, 0.5, 0.5)
E. color(0.333, 0.666, 1)
What color is 1/3 of the way from black to white?

A. color(0, 0, 0)
B. color(0.333, 0.333, 0.333)
C. color(0, 0.333, 0.666)
D. color(0.5, 0.5, 0.5)
E. color(0.333, 0.666, 1)
• Which part of the for loop is this?

```java
for (int i = 0; i < 16; i++) {
    // stuff to be repeated
    ellipse(100 + 25*i, 100, 15, 15);
}
```

A. Starting value
B. Test
C. Increment
D. Base case
E. Body
Which part of the for loop is this?

```java
for (int i = 0; i < 16; i++) {
    // stuff to be repeated
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A. Starting value
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E. Body
What is a visually distinguishing feature of Jackson Pollock works?
A. Bright colors
B. Geometric designs
C. Use of symbolism
D. Use of randomness
E. Anatomical correctness
What is a visually distinguishing feature of Jackson Pollock works?
A. Bright colors
B. Geometric designs
C. Use of symbolism
D. Use of randomness
E. Anatomical correctness
What is the return type of the function below?

A. int  
B. float  
C. void  
D. The function never returns so it does not have a return type.  
E. The code has an error, so Processing will reject it.

```java
int big(int n) {
    if(n <= 1) {
        return 1;
    }
    return n * big(n + 1);
}
```
What is the return type of the function below?

A. int
B. float
C. void
D. The function never returns so it does not have a return type.
E. The code has an error, so Processing will reject it.

```java
int big(int n) {
    if(n <= 1) {
        return 1;
    }
    return n * big(n + 1);
}
```
How many times will the `rect()` function be called by `draw()`?

A. 0
B. 1
C. 2
D. 3
E. 4

```cpp
void draw() {
  fill(0);
  house(100, 200);
  house(200, 200);
}

void house(int x, int y) {
  rect(x, y, 100, 100);
  triangle(x, y, x+100, y, x+50, y-50);
  rect(x+80, y+80, 10, 20);
}
```
How many times will the \texttt{rect()} function be called by \texttt{draw()}?

A. 0
B. 1
C. 2
D. 3
E. 4

```java
void draw() {
    fill(0);
    house(100, 200);
    house(200, 200);
}
```

```java
void house(int x, int y) {
    rect(x, y, 100, 100);
    triangle(x, y, x+100, y, x+50, y-50);
    rect(x+80, y+80, 10, 20);
}
```
How many rings will the rightmost target have?

A. No rings

B. 4

C. 6

D. 7

E. 10

```java
void draw() {
    drawTarget(width*0.25, height*0.4, 200, 4);
    drawTarget(width*0.5, height*0.5, 300, 10);
    drawTarget(width*0.75, height*0.3, 120, 6);
}

void drawTarget(float xloc, float yloc, int size, int num) {
    float grayvalues = 255/num;
    float steps = size/num;
    for (int i = 0; i < num; i++) {
        fill(i*grayvalues);
        ellipse(xloc, yloc, size - i*steps, size - i*steps);
    }
}
```
How many rings will the rightmost target have?

A. No rings
B. 4
C. 6
D. 7
E. 10

```c
void draw() {
    drawTarget(width*0.25, height*0.4, 200, 4);
    drawTarget(width*0.5, height*0.5, 300, 10);
    drawTarget(width*0.75, height*0.3, 120, 6);
}

void drawTarget(float xloc, float yloc, int size, int num) {
    float grayvalues = 255/num;
    float steps = size/num;
    for (int i = 0; i < num; i++) {
        fill(i*grayvalues);
        ellipse(xloc, yloc, size - i*steps, size - i*steps);
    }
}
```
What is the length of the lines drawn by this program?

A. 10  
B. 20  
C. 90  
D. 100  

```java
boolean flag = true;
void draw(){
    if(flag){
        stroke(255,0,0);
    }
    else{
        stroke(0,255,0);
    }
    for(int i=1; i<=10; i++){
        line(i*10,10,i*10,100);
    }
}

void setup(){
    size(110,110);
    background(255);
    strokeWeight(2);
}

void mouseClicked(){
    flag = (!flag);
}
```
What is the length of the lines drawn by this program?

A. 10  
B. 20  
C. 90  
D. 100
What does the function stroke() do?

A. Sets the color used to draw lines and borders around shapes
B. Sets the width of the stroke used to draw lines and borders around shapes
C. Disables drawing the stroke (outline)
D. Sets the style of joins which connects line segments

```java
boolean flag = true;
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        line(i*10,10,i*10,100);
    }
}

void setup(){
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    background(255);
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}

void mousePressed(){
    flag = (!flag);
}
```
What does the function `stroke()` do?

A. Sets the color used to draw lines and borders around shapes

B. Sets the width of the stroke used to draw lines and borders around shapes

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  for(int i=1; i<=10; i++)
    line(i*10,10,i*10,100);
}

void setup()
{
  size(110,110);
  background(255);
  strokeWeight(2);
}

void mousePressed()
{
  flag = (!flag);
}
```
What happens when you click the mouse?

A. The color of the lines switches between red and blue
B. The color of the lines switches between red and green
C. The stroke weight gets bigger
D. Nothing happens

```java
boolean flag = true;
void draw(){
    if(flag){
        stroke(255,0,0);
    }
    else{
        stroke(0,255,0);
    }
    for(int i=1; i<=10; i++){
        line(i*10,10,i*10,100);
    }
}
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    size(110,110);
    background(255);
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void mousePressed(){
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        stroke(255,0,0);
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    else
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        stroke(0,255,0);
    }
    for(int i=1; i<=10; i++)
    {
        line(i*10,10,i*10,100);
    }
}

void setup()
{
    size(110,110);
    background(255);
    strokeWeight(2);
}

void mousePressed()
{
    flag = (!flag);
}
```
Given the coordinates and size on the diagram, which command will draw the circled line?

A. line(x+s,y,x+s,y+s)
B. line(x,y,x+y,y+x)
C. line(x+3,y,x+3,9)
D. line(x+3*s,y,x+3*s,y+9*s)
Given the coordinates and size on the diagram, which command will draw the circled line?

A. line(x+s,y,x+s,y+s)
B. line(x,y,x+y,y+x)
C. line(x+3,y,x+3,9)
D. line(x+3*s,y,x+3*s,y+9*s)
- Which program could produce the image below?

// Program A
int i;
void draw() {
  background(175);
  noFill();
  i = (i + 10) % 100;
  ellipse(mouseX, mouseY, i, i);
}

// Program B
void draw() {
  background(175);
  noFill();
  for(int i = 0; i < 100; i = i + 10) {
    ellipse(mouseX, mouseY, i, i)
  }
}
• Which of the following creates a link in an HTML page?

A. `<link src="holiday.html" text="Holiday">`
B. `<img src="holiday.html">Holiday</img>`
C. `<a src="holiday.html">Holiday</a>`
D. `<a href="holiday.html">Holiday</a>`
E. `<link href="holiday.html">Holiday</link>`
• Which of the following creates a link in an HTML page?
A. `<link src="holiday.html" text="Holiday"/>
B. `<img src="holiday.html">Holiday</img>
C. `<a src="holiday.html">Holiday</a>
D. `<a href="holiday.html">Holiday</a>
E. `<link href="holiday.html">Holiday</link>`
Your friend called and said his website just got crawled by Google. What does that mean?

A. Google downloaded the content of his webpage.
B. Google intercepted information as a visitor read his page.
C. The keywords that appear on his page are not incorporated into the Google index.
D. If you search for your friend's name his website will appear high up on the search results.
Your friend called and said his website just got crawled by Google. What does that mean?

A. Google downloaded the content of his webpage.
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C. The keywords that appear on his page are not incorporated into the Google index.
D. If you search for your friend's name his website will appear high up on the search results.
• How valuable is one Bitcoin? (As of March 13, 2014)
A. Bitcoins are purely virtual so have no actual value.
B. One Bitcoin is worth more than $1000.
C. One Bitcoin is worth about $650.
D. Because Bitcoins can be saved and spent pseudonymously they can't be compared in value to dollars.
E. Bitcoins are worth whatever someone will give you for them, so you can't really put a "dollar value" on them.
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Lecture 15

- Linear time
- Quadratic time
- Big O
- Quicksort
- Polynomial time
- NP-Hard and NP-Complete (examples)
- Halting problem
You are an assistant in an introductory computer science class.
You have a long list of names of students who were caught cheating on the homework, sorted by last name.
For a given student, how many comparisons does it take you to figure out whether they are on the cheater list if you do it most efficiently? (n is the number of cheating students)

A. O(n)
B. O(n^2)
C. O(log(n))
D. O(n·log(n))
E. Another function
You are an assistant in an introductory computer science class.

You have a long list of names of students who were caught cheating on the homework, sorted by last name.

For a given student, how many comparisons does it take you to figure out whether they are on the cheater list if you do it most efficiently? (n is the number of cheating students)

A. \(O(n)\)
B. \(O(n^2)\)
C. \(O(\log(n))\)
D. \(O(n \cdot \log(n))\)
E. Another function
• Which of the following is true about the Quicksort algorithm?
A. It is a divide-and-conquer algorithm.
B. On average it runs faster than selection sort.
C. It is possible to prove that it works correctly.
D. It is a recursive algorithm.
E. All of the above.
• Which of the following is true about the Quicksort algorithm?
A. It is a divide-and-conquer algorithm.
B. On average it runs faster than selection sort
C. It is possible to prove that it works correctly
D. It is a recursive algorithm.
E. All of the above.
• With enough computing power, any problem can eventually be solved with an algorithm.

A. True, for any sensible definition of "problem".  
B. True, but some problems are so hard that it will take longer than the age of the universe to solve them.  
C. False, there are some problems that cannot be solved with an algorithm even theoretically.
With enough computing power, any problem can eventually be solved with an algorithm.

A. True, for any sensible definition of "problem".
B. True, but some problems are so hard that it will take longer than the age of the universe to solve them.
C. False, there are some problems that cannot be solved with an algorithm even theoretically.

Halting Problem
• How many Xzibit faces will be drawn?

A. 3
   void draw() {
      meme(100, 200, 3);
   }

B. 4
   }

C. 8
   void meme(float x, float y, int level) {
      if (level <= 1) {
         draw_xzibit_face(x, y, 10);
         return;
      }
      meme(x, y+10, level-1);
      meme(x+20*level, y+10, level-1);
   }

D. 16

E. 32
• How many Xzibit faces will be drawn?
A. 3
B. 4
C. 8
D. 16
E. 32

• meme(100, 200, 3)
  • meme(100, 210, 2)
    • meme(100, 220, 1)
      • draw_xzibit_face(100, 220, 10)
    • meme(140, 220, 1)
      • draw_xzibit_face(140, 220, 10)
  • meme(160, 210, 2)
    • meme(160, 220, 1)
      • draw_xzibit_face(160, 220, 10)
    • meme(200, 220, 1)
      • draw_xzibit_face(200, 220, 10)

void draw() {
    meme(100, 200, 3);
}

void meme(float x, float y, int level) {
    if (level <= 1) {
        draw_xzibit_face(x, y, 10);
        return;
    }
    meme(x, y+10, level-1);
    meme(x+20*level, y+10, level-1);
}
• How could you program a remote controlled toy car to do tricks?

A. You can use Processing with extensions to control digital inputs and outputs on an Arduino controlling the motors.

B. You need to use a special language designed for real-time motor control, then you could program each trick.

C. You would need to precompute all the motor speeds using a supercomputer to plan the sequence of outputs ahead of time.
• How could you program a remote controlled toy car to do tricks?

A. You can use Processing with extensions to control digital inputs and outputs on an Arduino controlling the motors.

B. You need to use a special language designed for real-time motor control, then you could program each trick.

C. You would need to precompute all the motor speeds using a supercomputer to plan the sequence of outputs ahead of time.
End