Algorithms in the Real World

1) **Mr. Kenan to the Rescue**: Mr. Kenan is part of a firefighting unit that specializes in saving people from big building fires. It can be very dangerous for firemen to go to every room to check if there is someone inside, so he wants to design a search and rescue robot that can for people trapped in a burning building.

    How can he program a robot that will
    a) go to each room
    b) check whether or not there is a person in the room
    c) check whether or not that person is conscious and
    d) report on the status of each room to Mr. Kenan and his unit?

2) **Hairpocalypse**: Mr. Kenan is stressing out, because he is about to meet his girlfriend's parents for the first time next week. One of the things he is most worried about is his bald head and what her parents will think. He quickly realizes that he needs to buy some HairGro, but his local stores charge a fortune for it and he thinks he can find it online for $20 or less.

    Help him search the Internet for the best price (and fastest shipping?) by comparing prices from at least 10 online retailers (Amazon, Target.com, etc.)

3) **Animl**: Mr. Kenan is going on a safari, but he's too lazy to carry around a field guide, so he decides to build a smartphone app that can help him classify an animal based on its characteristics.

    How would he write an app that will take a picture and identify the animal from the following list of possible animals?

|	
Elephant	Mandrill
Lion	Crocodile
Giraffe	Stork
Hyena	Hornbill
Meerkat	Warthog

4) **Homer the Homework Robot**: Mr. Kenan is too lazy to do his trigonometry homework, so he writes a program to do his homework for him. For each of his homework problems, he is given an angle (in degrees) and the length of the opposite side, and he is asked to figure out the other angles and side lengths.

$$SIN\,\theta = \frac{Side\ Opposite}{Hypotenuse}$$

$$COS\,\theta = \frac{Side\ Adjacent}{Hypotenuse}$$

$$TAN\,\theta = \frac{Side\ Opposite}{Side\ Adjacent}$$
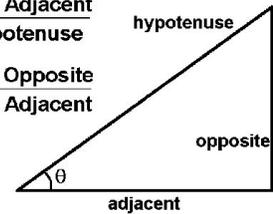
How can he tell his computer how to solve his trig problems for him?

5) **Musical Mess**: Mr. Kenan's computer got a weird bug and now his music library is all out of order. He wants to rearrange his songs to put them back in the correct alphabetical order by artist.

Based on the following list of artists, what instructions can he give his computer so that his music library is organized once again?

Alicia Keys	Bruce Springsteen
Queen	Elvis Presley
John Legend	Beatles
Led Zeppelin	Michael Jackson
Boyz II Men	Stevie Wonder

6) **We All Scream for Ice Cream**: Mr. Kenan is about to open an ice cream shop, and he is trying to figure out what his 10 starting flavors should be. He sets up a booth outside Kroger and asks people to give a thumbs up or thumbs down based on a taste test.

Help him write a program to figure out which of the following flavors are best, and to create a ranking from 1 to 10 based on the ratings of thumbs up and thumbs down for each flavor.

Vanilla	Durian
Mint Chocolate Chip	Mango
Rocky Road	Strawberry
Spumoni	Green Tea
Corn	Bacon

Suggested Solutions

Mr. Kenan to the Rescue!

The robot should iterate through rooms using a loop (for loop or while loop is fine). At each room, it should use some sensor that can determine yes/no if there is a person in the given room (sensor capabilities are not important - just assume the sensor can detect the presence of a person). If there is a person in the room, the robot plays a sound (e.g. "Are you hurt?") and listens for a response: if there is a response, then the robot determines that the person is conscious; if not, the person is unconscious or dead. Either way, the robot reports on the status of each room before moving on to the next room.

```
while rooms = true
        move to nextroom
        use person-sensor
        if person-sensor = true
                givenroom = person in danger
                play sound
                if response = true
                        person = conscious
                else
                        person = unconscious
        else
                givenroom = all clear
        report givenroom to firemen
```

Hairpocalypse

The program should first define a variable that stores the lowest price. (Explain that a variable is something like an imaginary box that stores a value, but can be overwritten.) It should iterate through a list of online retailers using "search", a function that reports the price of HairGro at that retailer. (Make up

```
lowest price = 20
list = [Amazon, Target, Walmart…]
for k = number of items in list
        check price
```

> *if price < lowest price*
>> *lowest price = price*
> *print "The lowest price is* lowest price *at* retailer"

Animl

The app should first prompt the user to take a picture of an animal. Using the picture as input, it should determine (don't worry about computer vision or object recognition) what kind of animal is in the picture based on an internal classification tree. It should then report the name of the animal in the picture. (This particular problem can have MANY solutions, depending on which characteristics students choose to use as classifiers.)

take picture
if animal has wings
> *if animal has feathers*
> *elseif animal has compound eyes*

else
> *if animal has fur*
> *elseif animal has scales*
>
> *.*
> *.*
> *.*

Homer the Homework Robot

The robot basically calculates all of the unknown values of a right triangle using the sine/cosine functions and the Pythagorean Theorem, based on the known values (the program can take these in as user input) of the sine of one of the angles and the length of its opposite side. They do not actually need to do calculations themselves - point out that this is why Mr. Kenan is writing a program!

sine = user input
opposite side = user input
hypotenuse = opposite side / sine
angle 1 = inverse sine (opposite side / hypotenuse)
angle 2 = 90 - angle 1
adjacent side = square root (hypotenuse squared - opposite side squared)

Musical Mess

The program should iterate through a list of 10 songs by different artists. The song should be placed ahead of a song if the artist is (Assume that the computer knows about alphabets.) There are a few ways to do this, but we haven't really discussed lists or arrays so it might be necessary to explain the concept.

Pick song with artist name
for songs
      if first letter of artist name < first letter of artist of song X in the list
          put song before song X
      elseif first letter of artist name > first letter of artist of song X in the list
          put song after song X
      else (i.e. first letters match)
          if second letter of artist name < second letter of artist of song X in the list
              put song before song X
          elseif second letter of artist name > second letter of artist of song X in the list
              put song after song X

We All Scream For Ice Cream

The program should iterate through flavors and ask for user input on each flavor. It should then add the user rating to the previous flavor rating (easiest to implement as a net rating). There are a few ways to do this, but we haven't really discussed lists or arrays so it might be necessary to explain the concept.

flavors = [chocolate, strawberry, vanilla, etc]
for k = flavors
      ask for user input
      if thumbs up
          flavors[k] = flavors[k] + 1
      else (i.e. thumbs down)
          flavors[k] = flavors[k] - 1