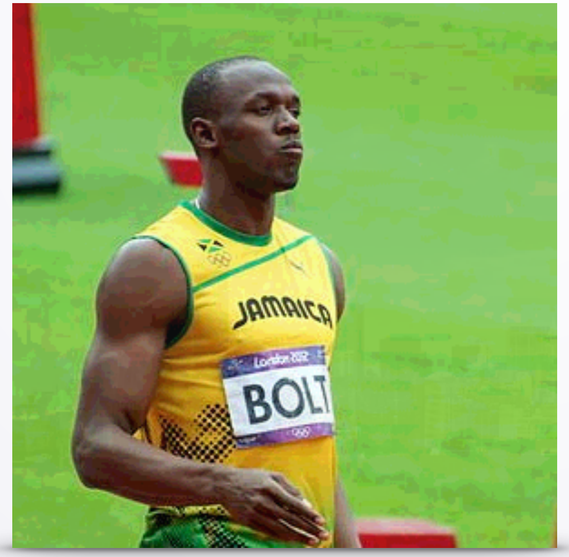
Steganography

Hiding Data in Images

Steganography to Explore Coding

- Steganography is the hiding of data in an image or other digital artifact
  - Originally not digital, invisible ink, wax tablets
  - Hiding text harder than hiding images



Usain Bold by Nick Webb/CC-by-2.0

Coding Challenge for You

- You will be able to find hidden meaning in the universe!
  - You'll see code to hide one image in another
  - Challenge: write code to extract hidden image

You are learning about a new, digital world --- a world in which you can create things like web pages and programs and then share them with your friends or everyone.

How to Hide Data in Pixels?

- Pixels have Red, Green, Blue components
  - Each is a value between 0 and 255

How to Hide Data in Pixels?

- Pixels have Red, Green, Blue components
  - Each is a value between 0 and 255
  - Is there a big difference between 240 and 255?
- Half a pixel for hiding
  - We'll do math!
  - Explain Decimal
    - Use binary/hex

From Base 10 to RGB Bits

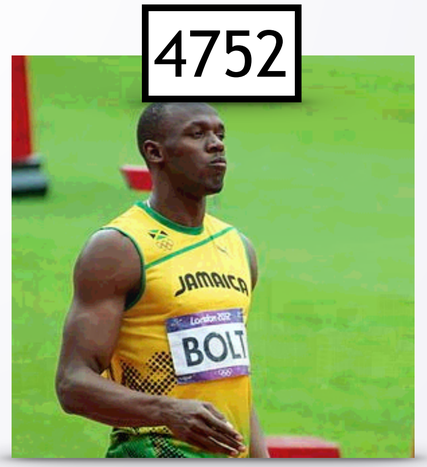
- Illustrate concept with four-digit number
  - Use start image and hide image to explain
  - Start: keep left two digits, clear right for hiding
  - Hide: move left two to be right two, hide them
  - New pixel is sum of start + hide

start

+

hide

=



From Base 10 to RGB Bits

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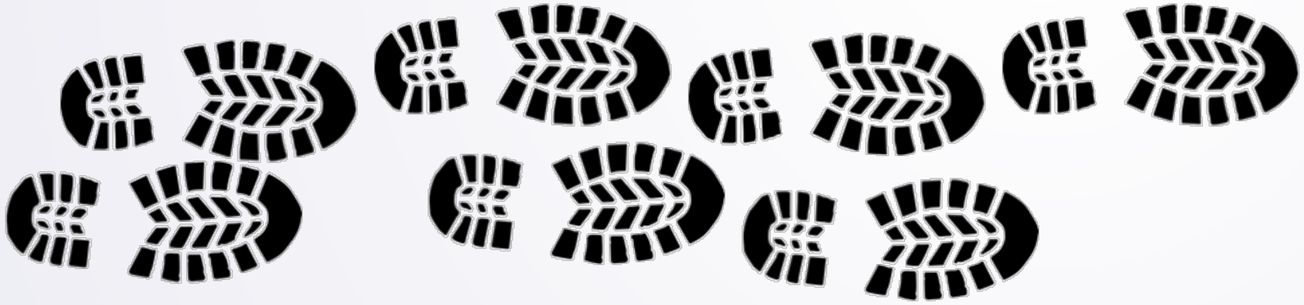
```
start: 4781          4700
hide:  5236        + 0052
                   ------
                     4752
```

Math from Base 10 to Base 2

- How to keep left 2 digits, clear right 2?
  - From 4781 to 4700
    - 4700/100 = 47 and 47*100 = 4700
  - Patterns: what about 3827?
    - 3827/100 = 38 and 38*100 = 3800



Seven Step Process

Math from Base 10 to Base 2

- How to keep left 2 digits, clear right 2?
  - From 4781 to 4700
    - 4700/100 = 47 and 47*100 = 4700
  - Patterns: what about 3827?
    - 3827/100 = 38 and 38*100 = 3800
- We use 100 for two digits in base 10
  - What about four digits in base 2? Divide by 2^4
  - Or one digit in hex/base 16? Divide by 16^1

Clearing Pixels for Hiding Data

- Instead of (1792/100) * 100 we use 16=2^4

```
function pixchange(pixval){
    var x = Math.floor(pixval/16) * 16;
    return x;
}
function chop2hide(image){
    for(var px of image.values()){
        px.setRed(pixchange(px.getRed()));
        px.setGreen(pixchange(px.getGreen()));
        px.setBlue(pixchange(px.getBlue()));
    }
    return image;
}
```

Clearing Pixels for Hiding Data

- Instead of (1792/100) * 100 we use $16=2^4$
  - We use four of eight bits, one of two hex digits

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    }
    return image;
}
```

Helper Function

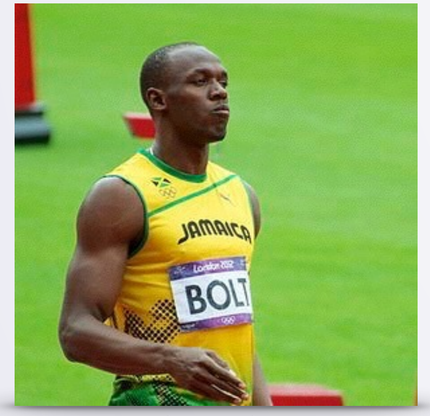
Creating New, Shifted Image to Hide

- In base 10 we want 4735 changed to 0047
  - Simply divide by 100; what about four bits?

```
function shift(im){
  var nim = new SimpleImage(im.getWidth(),
                            im.getHeight());
  for(var px of im.values()){
    var x = px.getX();
    var y = px.getY();
    var npx = nim.getPixel(x,y);
    npx.setRed(Math.floor(px.getRed()/16));
    npx.setGreen(Math.floor(px.getGreen()/16));
    npx.setBlue(Math.floor(px.getBlue()/16));
  }
  return nim;
}
```

Combining Start and Hide

- `start = chop2hide(start)`
- `hide = shift(hide)`
- How do we combine these?
  - From 4732 and 5789 we get 4700 + 0057
  - Results of `chop2hide(4732) + shift(5789)`

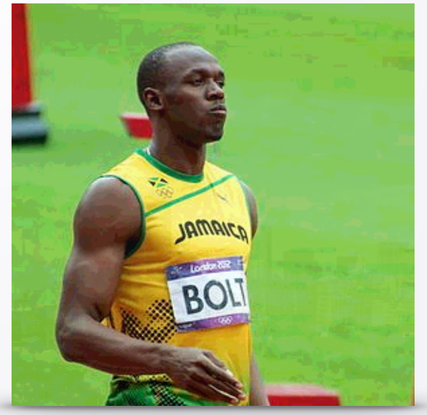


start

+

hide

=



Program to Create Hidden Data

- Once we write combine we have program to create steganographic, hidden data
  - Does order of arguments to combine matter?
  - How do we extract hidden data?

```
var start = new SimpleImage("usain.jpg");
var hide = new SimpleImage("skyline.jpg");

start = chop2hide(start);
hide = shift(hide);
var stego = combine(start,hide);
print(stego);
```