Datatypes and Variables

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Today's Goals

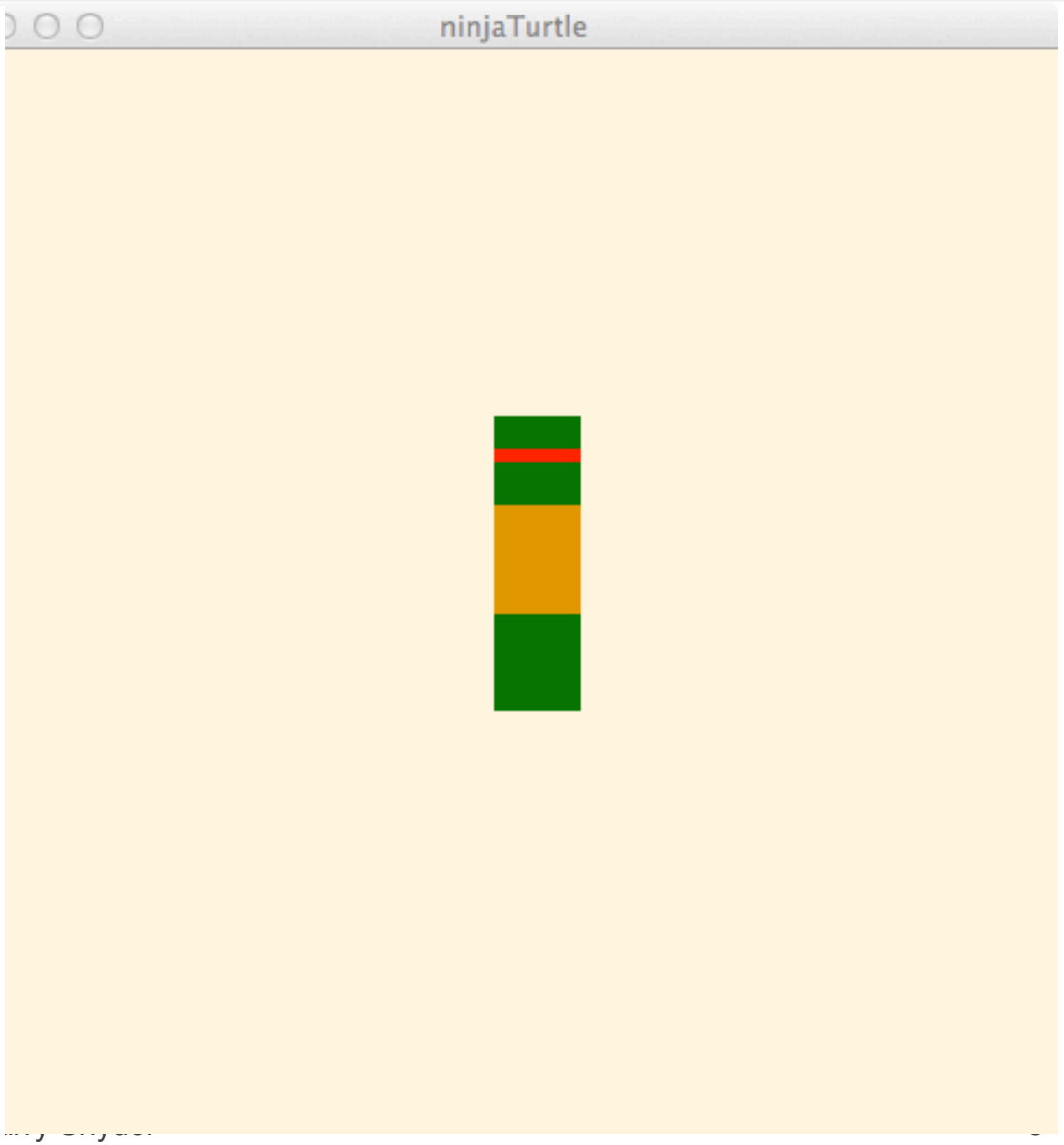
- We have three basic ideas to cover –
  - Datatypes
  - Declarations
  - Variables
- They all interact … we'll just start on these ideas today

Ninja! Example for Discussion

```
void setup( ) {
  size(500,500);
  noStroke();
}

void draw() {
  background(255, 245, 220);
  raff( );
}

void raff( ) {
  fill(0,100,0);
  rect(240   ,260, 40, 45);
  fill(219,136,0);
  rect(240   ,210, 40, 50);
  fill(0,100.0);
  rect(240   ,190, 40, 20);
  fill(255,0,0);
  rect(240   , 184, 40, 6);
  fill(0,100,0);
  rect(240   , 169, 40, 15);
}
```



Variables

- **variables** are names used in a program for quantities that vary … get it? Variables vary!
- So, one thing we can do is give them values:
  - `x = 12;`

  x is the variable, and it's being given the value 12
- Now, whenever I use the variable x, as in
  - `y = x + 1;`

it is as if I had used its value (12) directly: `y=12+1`

- It's pretty obvious … but there's more to it

Caution: variables are NOT unknowns

Datatypes

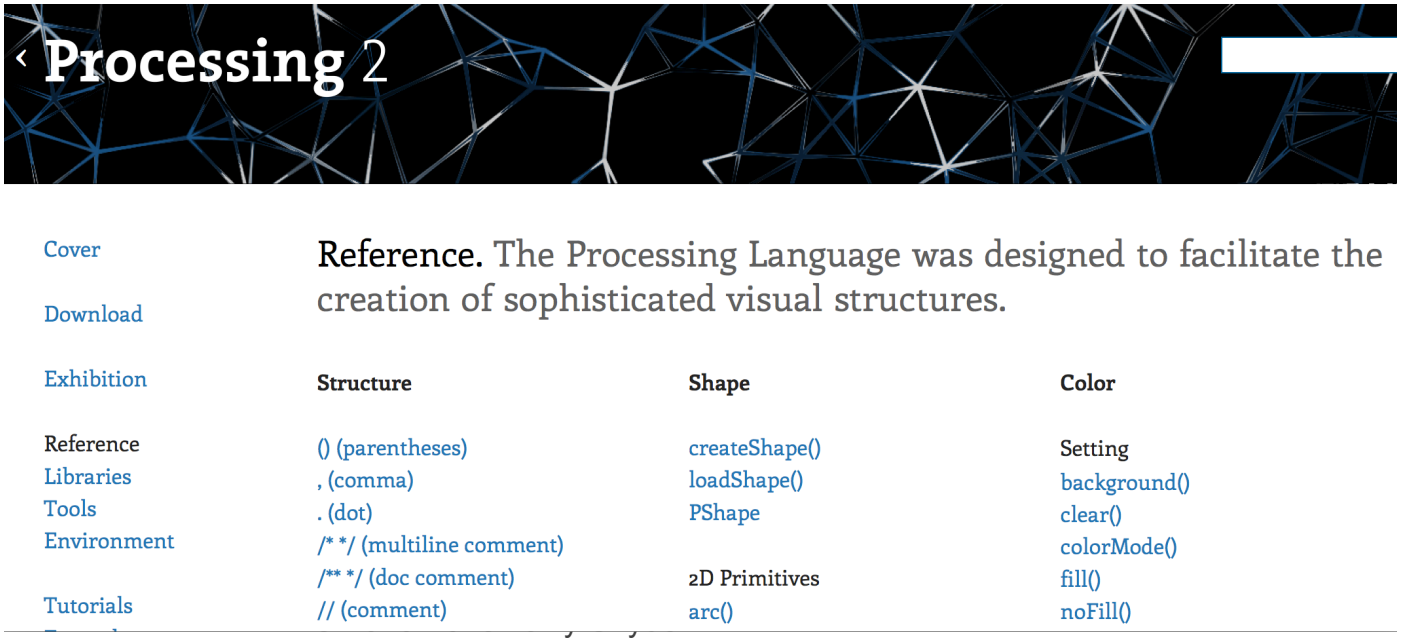
- The data that variables name has certain properties … we group information with similar properties into "types" --
  - integers, or whole numbers
  - floating point, usually called decimal numbers
  - colors, a triple of numbers for R, G and B
  - Etc.

Give Datatypes in Declarations

- Processing has a largish set of **datatypes**
- The most important datatypes for us are
  int, float, boolean and color

… we add more later

- Find details in the references



Tell Processing About Your Values

- Processing (and all languages) need to know the types of data you are working with
- We tell them the type by **declaring** a variable's datatype
- When declaring variables we list them after the type, as in
  - `int x, y, z;`
  - `float half_step = 0.5, whole = 1.0;`
  - `color yellow = color(200,200,0);`

Declaration & Variable Rules

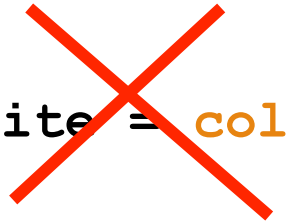
- Variables are case sensitive

```
int leftSide, left_side, leftside; // declare 3 vars
```

- Variables can be initialized

```
float temperature = 98.6;     // declare & initialize
```

- Variables names are meaningless to computers, but meaningful to people … don't lie

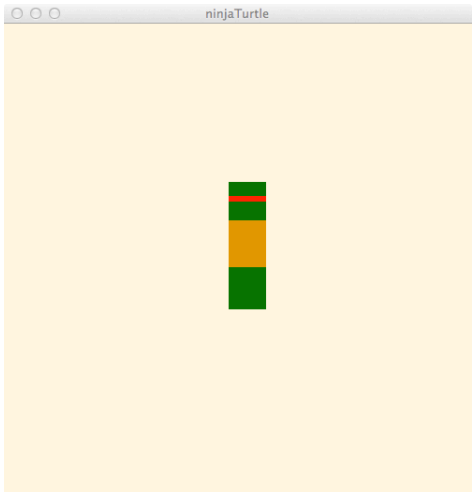


```
color myWhite = color(0,0,0); //White … ha, ha!
```

- Variables are best declared at top of a program

Add A Variable

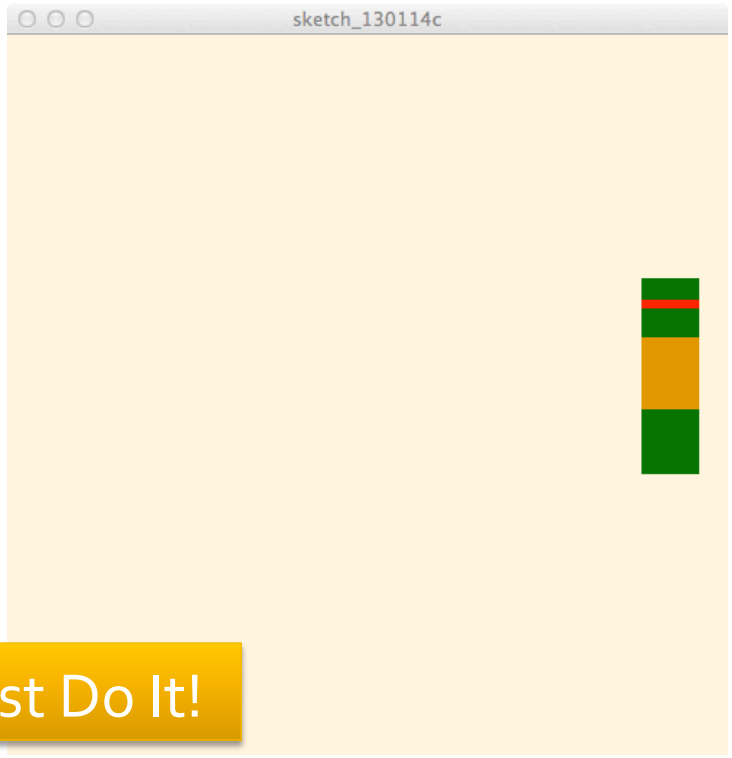
- Raphael gets a var
- Adding the variable value (0) to each horizontal position results in no change




```
int ra = 0;
void setup( ) {
  size(500,500);
  noStroke();
}
void draw() {
  background(255, 245, 220);
  raff();
}
void raff() {
  fill(0,100,0);
  rect(240+ra,260, 40, 45);
  fill(219,136,0);
  rect(240+ra,210, 40, 50);
  fill(0,100,0);
  rect(240+ra,190, 40, 20);
  fill(255,0,0);
  rect(240+ra, 184, 40, 6);
  fill(0,100,0);
  rect(240+ra, 169, 40, 15);
}
```

Change Value!

- When ra has the value of 200, Raff's position is changed

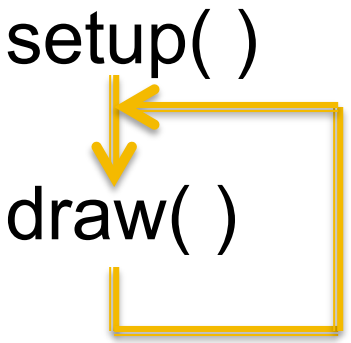


Just Do It!

```
int ra = 200;
void setup( ) {
  size(500,500);
  noStroke();
}
void draw() {
  background(255, 245, 220);
  raff();
}
void raff() {
  fill(0,100,0);
  rect(240+ra,260, 40, 45);
  fill(219,136,0);
  rect(240+ra,210, 40, 50);
  fill(0,100,0);
  rect(240+ra,190, 40, 20);
  fill(255,0,0);
  rect(240+ra, 184, 40, 6);
  fill(0,100,0);
  rect(240+ra, 169, 40, 15);
}
```

Recall setup( ) and draw( )

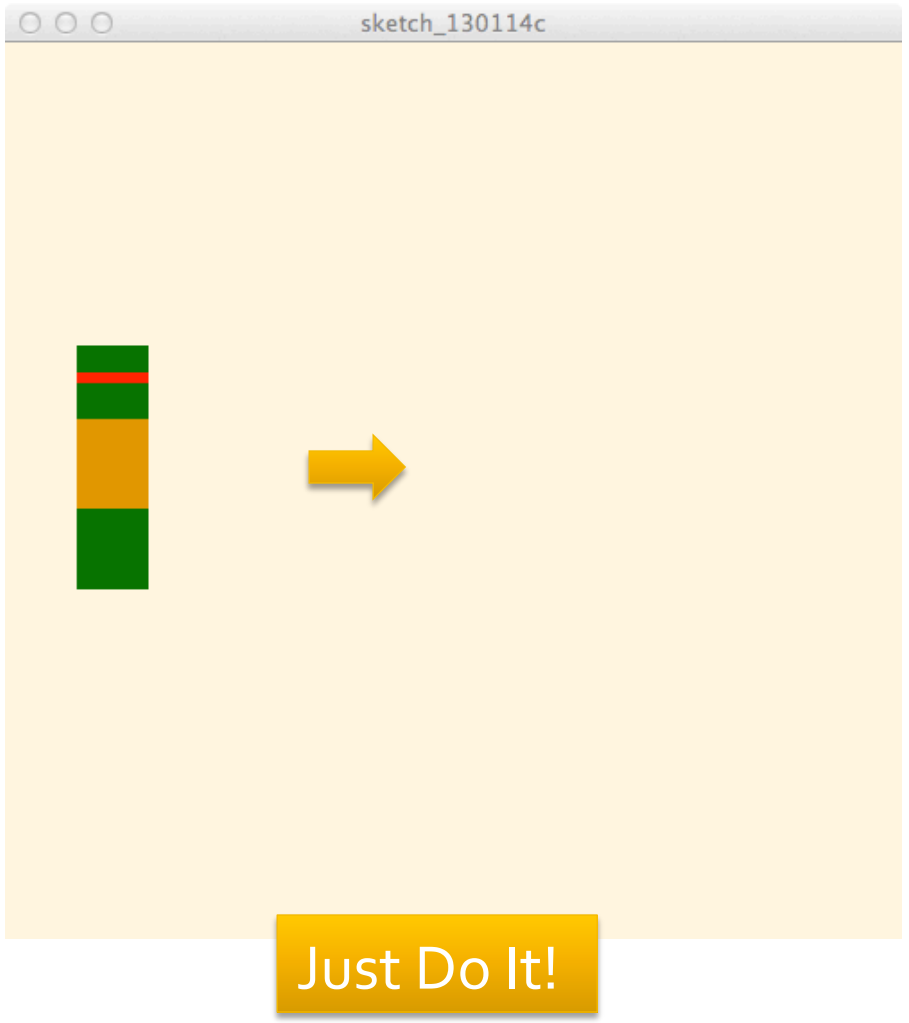
- The functions setup( ) and draw( ) allow the Processing computations to be dynamic
- Recall that they work as follows:



- Make Raphael run!

Start Raphael Left, Move Right

```
int ra = -200;
void setup( ) {
  size(500,500);
  noStroke();
}
void draw() {
  background(255, 245, 220);
  raff();
  ra = ra + 1;
}
void raff() {
  fill(0,100,0);
  rect(240+ra,260, 40, 45);
  fill(219,136,0);
  rect(240+ra,210, 40, 50);
  fill(0,100,0);
  rect(240+ra,190, 40, 20);
  fill(255,0,0);
  rect(240+ra, 184, 40, 6);
  fill(0,100,0);
  rect(240+ra, 169, 40, 15);
```



Make Him Appear

- Start Raff off-screen to right, by initializing him to … ?
- Then make him move left by … ?
- And speed his movement up by … ?

Just Do It!

Raff The Left Running Ninja

- Note 400 is enough to hide him off screen
- Subtracting moves him left
- Changing `ra` by 2 speeds him up

```
int ra = 400;

void setup( ) {
  size(500,500);
  noStroke();
}
void draw() {
  background(255, 245, 220);
  raff( );
  ra = ra - 2; //Add 1 to ra
}
void raff( ) {
  fill(0,100,0);
  rect(240+ra,260, 40, 45);
  fill(219,136,0);
  rect(240+ra,210, 40, 50);
  fill(0,100,0);
  rect(240+ra,190, 40, 20);
  fill(255,0,0);
  rect(240+ra, 184, 40, 6);
  fill(0,100,0);
  rect(240+ra, 169, 40, 15);
}
```

New Variables Mean New Stunts

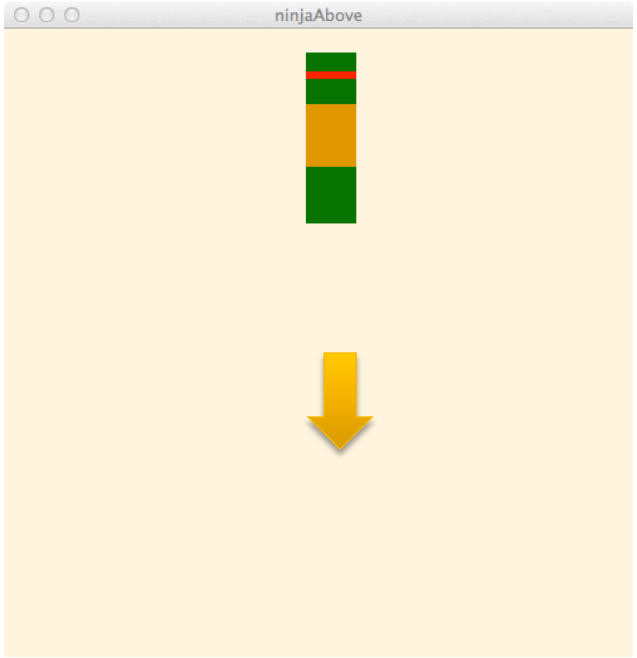
- Return to basic Raff, and declare five new variables of type float … and add to vertical dimension

```
float ua = 0;
float ub = 0;
float uc = 0;
float ud = 0;
float ue = 0;
    ...
void raff() {
  fill(0,100,0);
  rect(240,260+ua, 40, 45);
  fill(219,136,0);
  rect(240,210+ub, 40, 50);
  fill(0,100,0);
  rect(240,190+uc, 40, 20);
  fill(255,0,0);
  rect(240, 184+ud, 40, 6);
  fill(0,100,0);
  rect(240, 169+ue, 40, 15);
}
```

Add Some Action!

- We want Raff to drop down
  - Translate his position by -150
  - Add 1 to each new variable
  - … but, he doesn't stop

Just Do It!




```
float ua = -150;
float ub = -150;
float uc = -150;
float ud = -150;
float ue = -150;

void setup( ) {
  size(500,500);
  noStroke();
}

void draw() {
  background(255, 245, 220);
  raff();
  ua = ua + 1;
  ub = ub + 1;
  uc = uc + 1;
  ud = ud + 1;
  ue = ue + 1;
}
```

...

Analyze What Happens

- As the value of ua, say, changes, Raff's position changes …

```
fill(0,100,0);
rect(240,260+ua, 40, 45);
...
ua = ua + 1;
```

- Consider changes [position blue; ra red]
  - 110 = 260+(-150) // first time
    - -149 = -150 + 1
  - 111 = 260+(-149) // second time
    - -148 = -149 + 1
  - 112 = 260+(-148) // third time
    - -147 = -148 + 1

…

…

Continuing The Analysis

- The offset ua gets less and less negative, eventually getting to zero
  - 259 = 260+(-1)
    - 0 = -1 + 1
  - 260 = 260+0
    - 1 = 0 + 1

      ...
- We want to stop when ua gets to 0
- So, don't do `ua = ua+1`, write `ua = min(0,ua+1)`
- What happens??? min(a,b) gives the smaller of a, b

Check Out The min( ) Function

min(a,b) gives the smaller of a, b

- 110 = 260+(-150)
  - -149 = min(0,-150 + 1) — As before!
- 111 = 260+(-149)
  - -148 = min(0,-149 + 1) — As before!
- 112 = 260+(-148)
  - -147 = min(0,-148 + 1) — As before!

...

- 259 = 260+-(1)
  - 0 = min(0,-1 + 1) — No difference, as before!
- 260 = 260+0
  - 0 = min(0,0 + 1) — Stays at 0 … forever!

Raff Drops And Stops

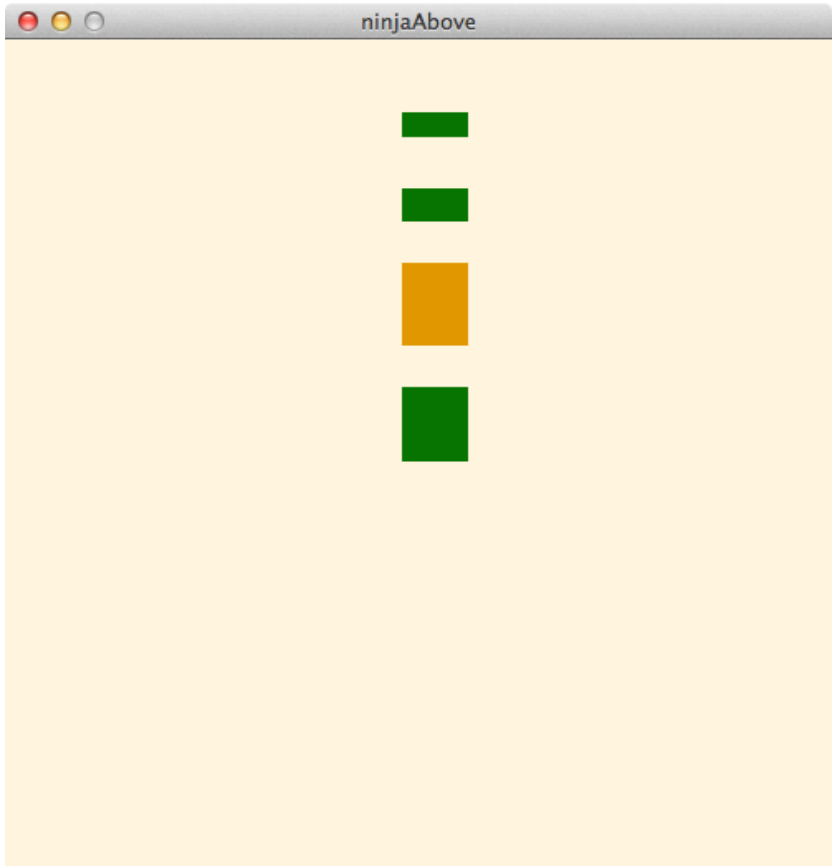
- The code simply applies the `min( )` function

```
void draw() {
  background(255, 245, 220);
  raff();
  ua = min(ua + 1,0);
  ub = min(ub + 1,0);
  uc = min(uc + 1,0);
  ud = min(ud + 1,0);
  ue = min(ue + 1,0);
}
void raff() {
  fill(0,100,0);
  rect(240,260+ua, 40, 45);
  fill(219,136,0);
  rect(240,210+ub, 40, 50);
  fill(0,100,0);
  rect(240,190+uc, 40, 20);
  fill(255,0,0);
  rect(240, 184+ud, 40, 6);
  fill(0,100,0);
  rect(240, 169+ue, 40, 15);
}
```

Just Do It!

Best Stunt Of All: Reform

- Change the amount Raff's parts fall so he appears to reassemble!



Requires float ud

```
void draw() {
  background(255, 245, 220);
  raff();
  ua = min(ua + 5,0);
  ub = min(ub + 4,0);
  uc = min(uc + 3,0);
  ud = min(ud + 0.75,0);
  ue = min(ue + 1,0);
}
```

Just Do It!

Summary

- Today, we learned about
  - variables … names for quantities that vary in the program
  - datatypes … forms of data like integers, floating point numbers (decimal numbers), colors, booleans, etc.
  - declarations … statements that define what datatype variables are, as in int ra = 0;
  - And we learned the min( ) function