THE ARDUINO
- WRITING ALGORITHMS

Dr Chris Dennett

Algorithm Design

- Definition: **A step-by-step procedure to solve a problem**
- Before we get anywhere near a piece of hardware or write any code we must work out what needs to be done
- PLAN
- DO
- CHECK

Algorithm Design

- Define the problem
  - Analyse the task
  - Ask yourself questions
  - State your assumptions – Do they make sense?
- Develop an algorithm
  - Break the task into steps that follow a sensible order
  - WRITE it down… On paper!!!!
- Test the algorithm
  - Work through your algorithm
  - Does it work properly?
  - If not, redevelop

Example – Do the laundry

- Define the problem
  - Start with assorted dirty clothes – End with clean, dry clothes
- Ask Questions
  - Where are the clothes?
  - What am I washing them in?
  - How many clothes can I wash in one go?
  - What other things do I have to take into account?

Example – Do the laundry

- Make sensible assumptions
  - I'm using a washing machine
  - I'm going to have to take account of the colour of the clothes
    - Decide on which powder to use
    - Decide which wash to choose
  - I'm going to have to think about the weight of the load
  - I'm going to have to look at the weather to decide on how to dry the clothes
  - I don't 'do' ironing!

Example – Do the laundry

- Write your algorithm
  - In as little (or as much) detail as you need
- Go to laundry basket
  - If no clothes in laundry basket go to bedroom
  - Pick clothes up off bedroom floor
- Put clothes in washing basket
- Take clothes to washing machine
- Stuff clothes in washing machine
- Chuck some powder in the right drawer

Example – Do the laundry

- Press ‘on’
- Wait for machine to finish
- Take washing out
- Put washing in dryer
- Wait for dryer to finish
- Stuff clothes in a drawer

Example – Do the Laundry

- Test your algorithm
  - Better to do it as thoroughly as possible on paper
  - Debugging code can be a pain – especially on the Arduino
- Run through the algorithm

Example – Do the Laundry

- …
- Take clothes to washing machine
- Stuff clothes in washing machine
  - ARG! Some of the clothes are colour and some are white!
  - Edit:
  - Take clothes to washing machine
  - Sort colours from whites
  - Stuff colours OR whites in washing machine

Example – Do the Laundry

- ARG! Too many clothes to fit in washing machine
  - Edit:
  - If number of clothes > washing machine safe load limit
    - While number of clothes > washing machine safe load limit
      - Remove item
    - Return
  - Return
- …
- Chuck some powder in the right drawer
- ARG! One powder for colours and another for whites

Example – Do the Laundry

- Edit:
  - If clothes = white
    - Choose powder ‘a’
  - Else
    - Choose powder ‘b’
  - End

Example – Do the laundry

- Press ‘on’
  - ARG! There’s loads of settings
  - Edit:
    - ~~Press ‘on’~~ Ask mum to choose suitable setting
    - Press ‘on’
- Wait for machine to finish
- Take washing out
- …

Example – Do the laundry

- Put washing in dryer
  - ARG! Mum says it's a waste of electricity
  - Edit:
    - Go outside
    - Look up
    - If sunny
      - Hang washing out
    - Else
      - Put washing in dryer
    - End
- Wait for dryer to finish

Final Algorithm

- Go to laundry basket
- If no clothes in laundry basket go to bedroom
  - Pick clothes up off bedroom floor
- Put clothes in washing basket
- Take clothes to washing machine
- Sort colours from whites
- Stuff colours OR whites in washing machine
- If number of clothes > washing machine safe load limit
  - While number of clothes is larger than washing machine safe load limit
    - Remove item
  - Return
- return
- If clothes are white
  - Choose powder ‘a’
- Else
  - Choose powder ‘b’
- End
- Chuck some powder in right drawer
- Ask mum to choose suitable setting
- Press ‘on’
- Wait for washer to finish
- Go outside
- Look up
  - If sunny
    - Hang washing out
  - Else
    - Put washing in dryer
  - End

Implementing Algorithm

- You'll notice that I have used code-like (pseudo code) statements in the algorithm design
  - If
  - Else
  - While
- These help the transition to program code

Implementing Algortihm

- From our algorithm
  - We can see where loops are
    - DON'T CONFUSE MY USE OF 'loop' with the 'loop' procedure in your sketch
    - The loop procedure is where you will put your algorithm. It repeats the algorithm
  - Here we mean smaller loops within the algorithm. Eg.
- If number of clothes > washing machine safe load limit
  - While number of clothes is larger than washing machine safe load limit
    - Remove item
  - Return
- return

Implementing Algorithm

- This would be analogous to
  - Int num_clothes; //Declared at the top
  - Int limit = 25;
  - If (num_clothes > limit){
    - While (num_clothes > limit){
      - Num_clothes = num_clothes – 1;
      - }
    - }

Implement Algorithm

- Write the sketch
- Test the sketch - Debugging
  - If it doesn't do what it is supposed to do, debug
  - On paper, write out what values everything should be at what point in the code
  - Check this against what you actually get
- Once you've tested it satisfactorily
- Use it!

Arduino

- When creating hardware and software combined packages, we need to break the problem into bite-sized chunks
  - Develop the hardware
    - Taking notes which Arduino pins interface with which parts of the circuit
    - Use simple bits of code and LEDs to debug the circuit
  - Develop the software
    - This is where we write the algorithm
    - When transitioning from our original algorithm to a sketch, first define/declare your pins as names that make sense

Arduino

- Developing the hardware first means that when you come debugging the code, you know that issues are only in the software
- So now, look back at your portfolio assignment and design your algorithm
- Start Here!