Everyday Algorithms

...a lightning introduction to algorithms

Building a table

Building a flat-pack table

12 × 🔩 (screw)

4 × ▭ (leg)

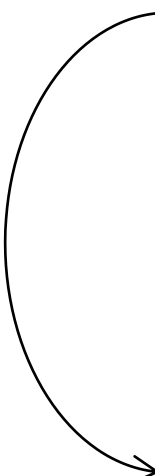4 × ◣ (flange)

1 × ▭ (top)
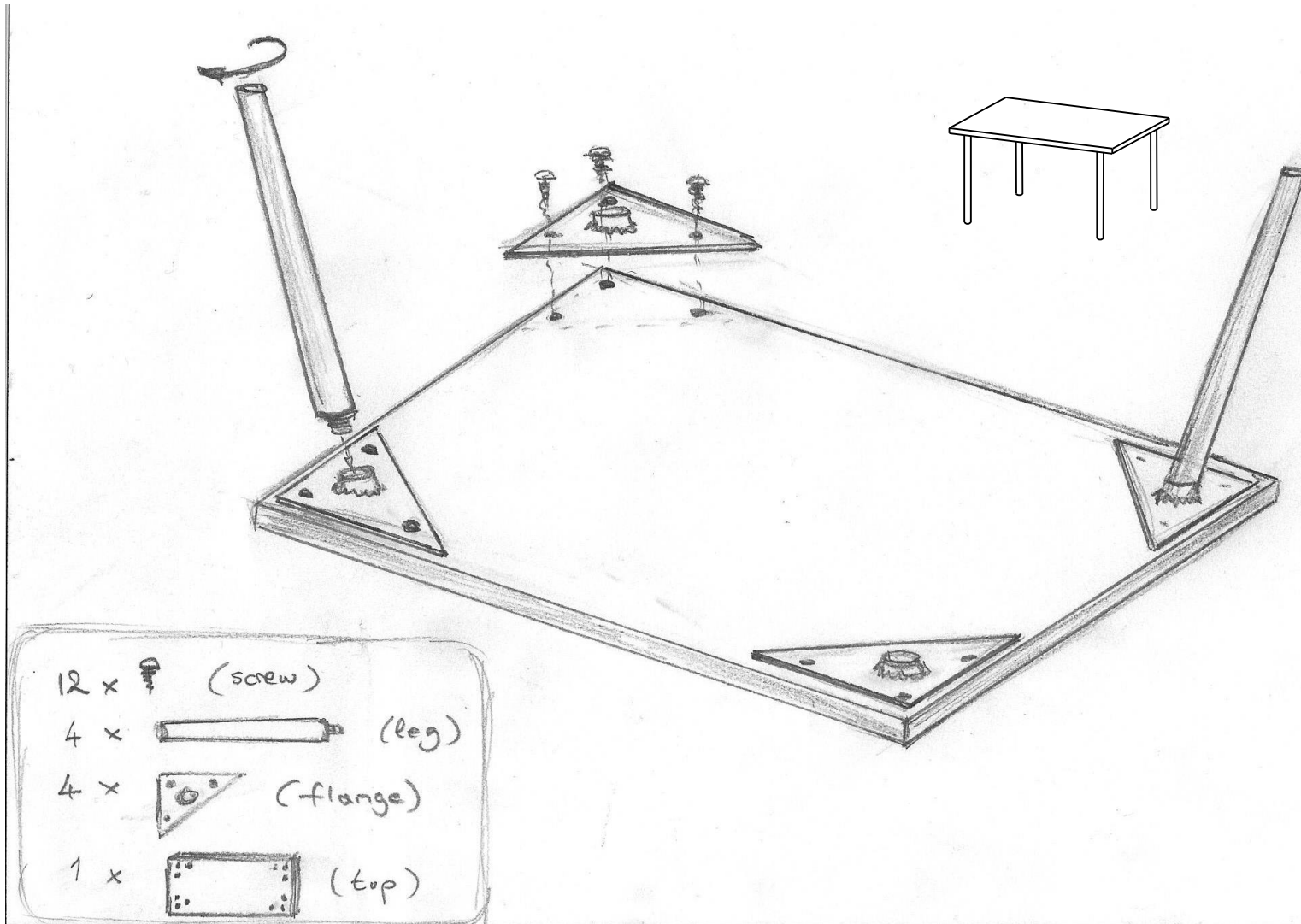
Building a flat-pack table

- Write the solution out in natural language.
- Refine the wording, make it as clear and concise as possible.
  - grammar not so important; "pseudocode"
- Number the steps   (1, 2, 3…) to indicate the order in which they must be done.
- Draw boxes around each of the sub-parts, especially those that are done repeatedly.
- Use indentation to clearly show sub-steps.

Building a flat-pack table

Lay the table top upside-down on the ground

Secure each of the four flanges to a corner of the table top using 3 screws each. Next, screw a table leg into each flange.

Turn the completed table the right way up!

1. For each corner of the table top

   secure the flange to the corner using 3 screws

2. For each flange

   screw a table leg into the flange

Building a flat-pack table

- IMPORTANT:
  - multiple equally correct solutions!
  - naturally have sequence of steps and repetition of steps.

- Another solution:
  - screw the legs into each of the flanges
  - screw each flange to a corner of the table top

Building a flat-pack table

Lay the table top upside-down on the ground

Attach a table leg to each corner of the table top.

Turn the completed table the right way up!

For each corner of the table top

attach a table leg to corner.

position a flange on the corner and secure it with 3 screws, then screw the leg into the flange.

For each corner of the table top

1. position a flange on the corner
2. secure flange in place with 3 screws
3. screw a leg into the flange

Building a flat-pack table

- Could you tell the difference?

For each corner of the table top

1. position a flange on the corner
2. secure flange in place with 3 screws
3. screw a leg into the flange

1. For each corner of the table top
   secure the flange to the corner using 3 screws

2. For each flange
   screw a table leg into the flange

Changing a flat tyre

Your turn…
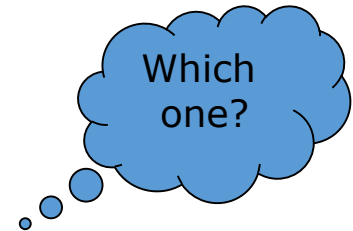
- Explain how to change a flat tyre.

Provide an "**algorithm**" (set of instructions or a procedure) that solves the problem.
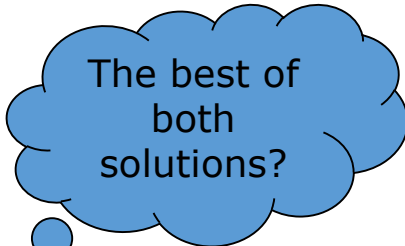
Changing a flat-tyre

Sample solution_1
1. Ensure the car is parked safely and cannot roll.
2. Remove wheel with flat tyre
3. Replace it with the spare wheel
4. Drive off

Which one?

Sample solution_2
1. Ensure the car is parked safely and cannot roll.
2. Take the jack, spanner and spare wheel from the trunk.
3. Slacken the wheel nuts on the wheel with the flat tyre
4. Jack the car up so the wheel with the flat tyre can be removed.
5. Remove all the nuts from wheel with the flat tyre
6. Take the wheel off and place it in the trunk
7. Put the spare wheel on in place of the one with the flat tyre
8. Put the nuts on and tighten as much as possible
9. Lower the car off the jack
10. Fully tighten the nuts on the new wheel
11. Put the jack and spanner back in the trunk
12. Drive off

Changing a flat-tyre

The best of both solutions?

Sample solution_3
1. Ensure the car is parked safely and cannot roll.
2. Remove wheel with flat tyre
    1. Take the jack, spanner and spare wheel from the trunk.
    2. Slacken the wheel nuts on the wheel with the flat tyre
    3. Jack the car up so the wheel with the flat tyre can be removed.
    4. Remove all the nuts from wheel with the flat tyre
    5. Take the wheel off and place it in the trunk
3. Replace it with the spare wheel
    1. Put the spare wheel on in place of the one with the flat tyre
    2. Put the nuts on and tighten as much as possible
    3. Lower the car off the jack
    4. Fully tighten the nuts on the new wheel
    5. Put the jack and spanner back in the trunk
4. Drive off

Changing a flat-tyre

Sample solution_4
1. Ensure the car is parked safely and cannot roll.
2. Remove wheel with flat tyre
3. Replace it with the spare wheel
4. Drive off

The best?

2. Remove wheel with flat tyre
1. Take the jack, spanner and spare wheel from the trunk.
2. Slacken the wheel nuts on the wheel with the flat tyre
3. Jack the car up so the wheel with the flat tyre can be removed.
4. Remove all the nuts from wheel with the flat tyre
5. Take the wheel off and place it in the trunk

3. Replace it with the spare wheel
1. Put the spare wheel on in place of the one with the flat tyre
2. Put the nuts on and tighten as much as possible
3. Lower the car off the jack
4. Fully tighten the nuts on the new wheel
5. Put the jack and spanner back in the trunk
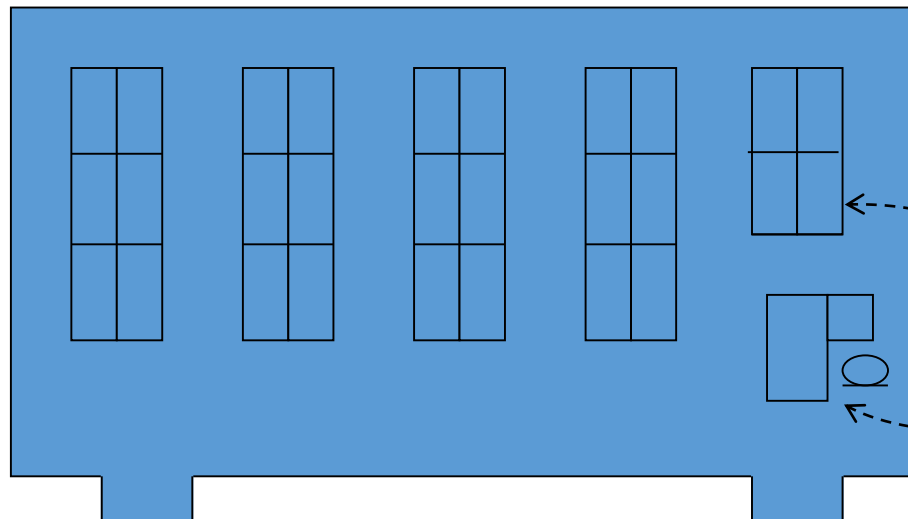
Changing a flat-tyre

- do high-level minimal solution first

- check & if ok

- then add detail to each piece as necessary

  - only need to think about piece, not whole

Supermarket shopping

Supermarket Shopping

List

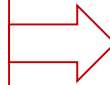Given a shopping list, go to the supermarket, buy all the items on it and take them home.

shelves

checkout

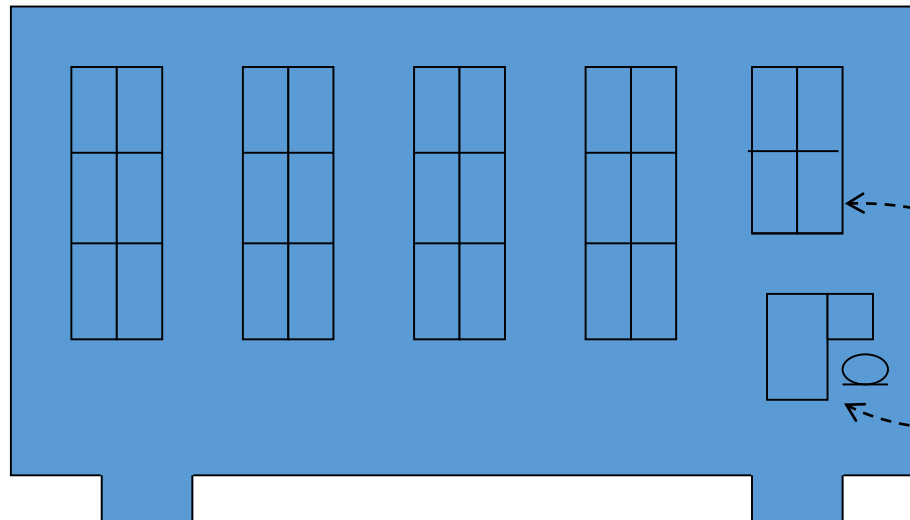entrance   exit

Supermarket Shopping

List
___
___
___
___

Given a shopping list, go to the supermarket, buy all the items on it and take them home.

1. With your shopping list, go to the market
2. From the market, buy the items on your shopping list.
3. Return home with the items you purchased.

shelves

checkout

entrance

exit

Supermarket Shopping

Collect a shopping cart on the way into the market. Walk around the market looking at the items on each shelf. If the item on the shelf is on your shopping list, take it from the shelf and add it to the items in your shopping cart. After visiting all the shelves, go to the checkout and pay for the items in your trolley. Leave the empty trolley and exit the market with the items you purchased.
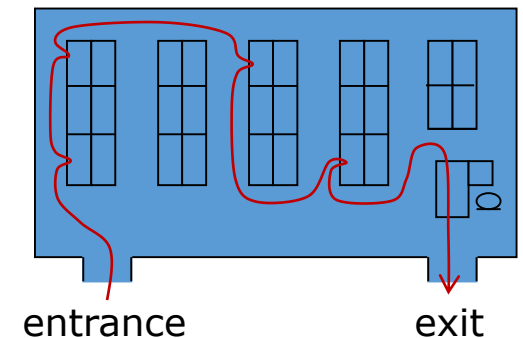
1. Get a shopping cart
2. For each shelf in the market
   - if the item on the shelf is on the list then
      - take the item from the shelf
      - add the item to the shopping cart
3. Go to checkout and pay for items in trolley
4. Leave market with items purchased.

entrance   exit
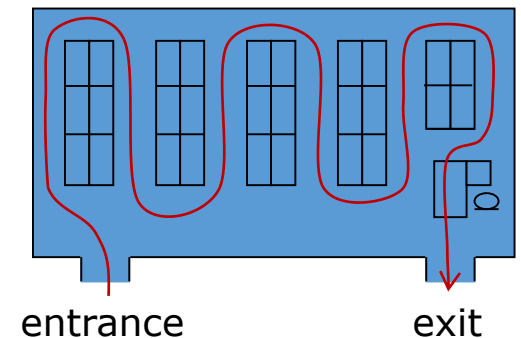
Supermarket Shopping (alternative solution)

Collect a shopping cart on the way into the market. For each item on your shopping list, go to the shelf containing the item, take it from the shelf and add it to the items in your shopping cart. After completing your shopping list, go to the checkout and pay for the items in your trolley. Leave the empty trolley and exit the market with the items you purchased.

1. Get a shopping cart
2. For each item on the shopping list

    if the item is in the market then

        go to the shelf with the item on

        take the item from the shelf

        add the item to the shopping cart

3. Go to checkout and pay for items in cart
4. Leave market with items purchased.

entrance   exit

Supermarket Shopping

Get a shopping cart

For each shelf in the market

    if the item on the shelf is on the list then

      take the item from the shelf

      add the item to the shopping cart

Go to checkout and pay for items in trolley

Possible Problems?
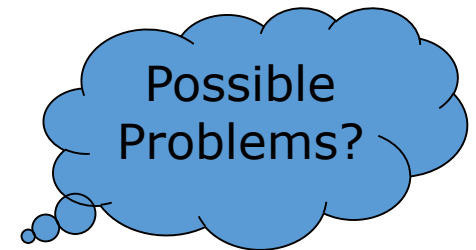
Get a shopping cart

For each item on the shopping list

    if the item is in the market then

      go to the shelf with the item on

      take the item from the shelf

      add the item to the shopping cart

Go to checkout and pay for items in cart

Which is best?

Supermarket Shopping

- Possible problems…
  - how might the shopping cart contain extra items?
  - how might the shopping cart be missing items?
  - if the item is on two or more shelves?
  - if the item on the list is not in the market?
  - inconsistencies in naming
  - frozen items last
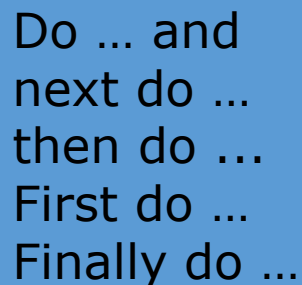 - delicate/crushable items on top of heavier ones.
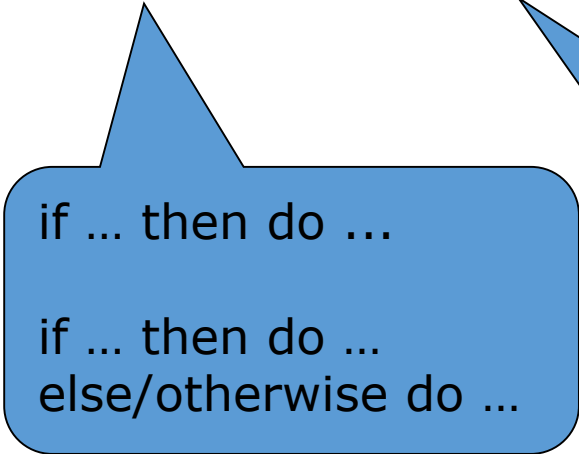
Key Ideas…

Terminology

- Algorithm
  - Sequence of steps to solve a problem
- Natural language
  - English, Turkish, French, German, …
- Computer code/program
  - Instructions a computer can "understand"
- Pseudocode
  - "False" code, semi-structured English
- Trace program or algorithm
  - you follow the steps (instead of machine!)

Algorithms

- An algorithm is a procedure/method comprising the steps to solve a given problem.
- It must
  - be understandable, effective, correct, & **must stop**
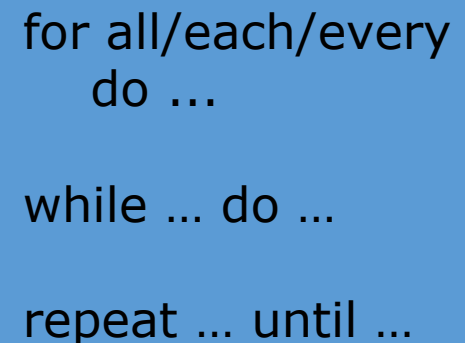- Algorithms comprise:
  - Sequence, decision, repetition

Do … and
next do …
then do …
First do …
Finally do …

if … then do …

if … then do …
else/otherwise do …

for all/each/every
do …

while … do …

repeat … until …

Tips…

- Be consistent in naming things
- Rewrite Natural language into "pseudocode" forms
  (take care with numbering, indentation)
- High-level solution first,
  then, after checking correctness
  and completeness,
  solve each piece separately
- Consider alternative solutions
  (may prefer some for other reasons)