Problems and Solutions

LEVELS 7-8

Define and decompose real-world problems taking into account functional requirements and economic, environmental, social, technical and usability constraints (ACTDIP027)

What type of career uses this knowledge?

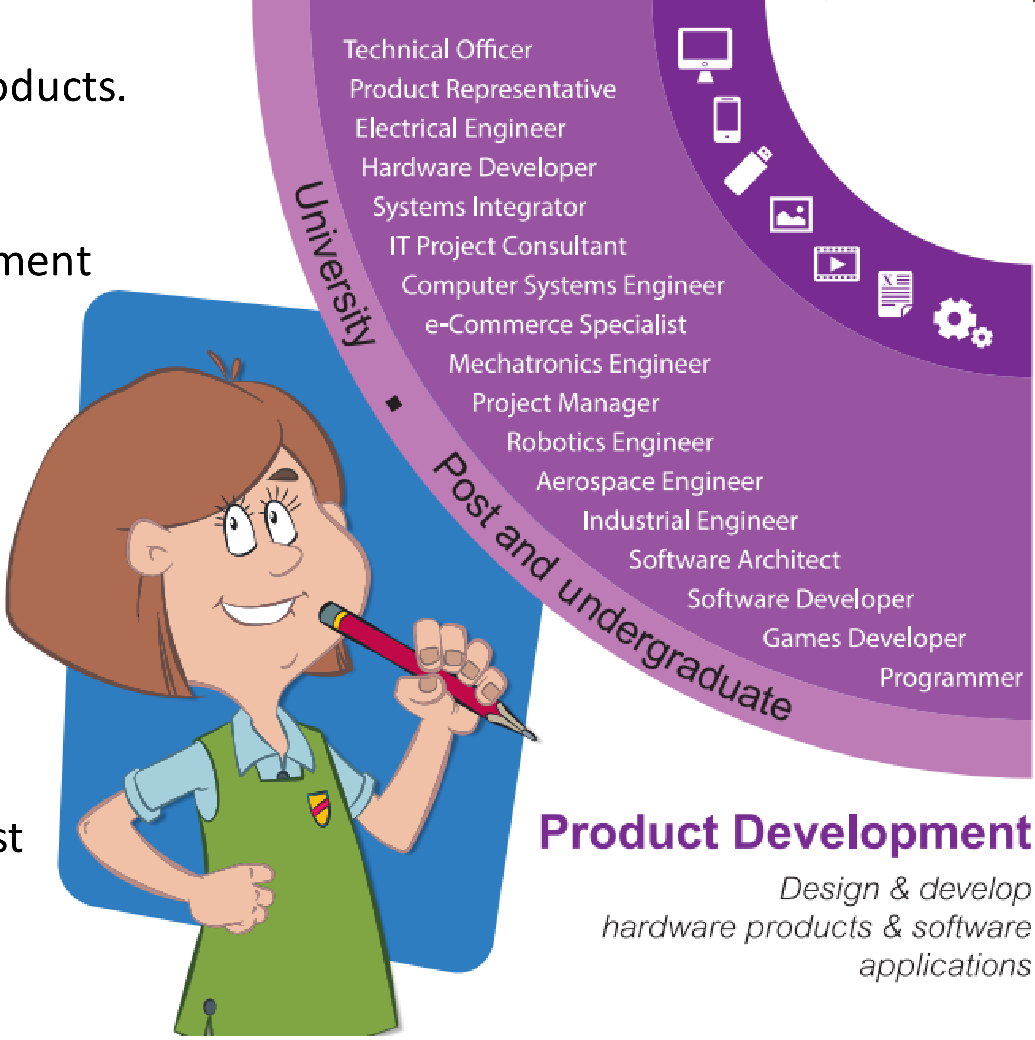
Use your coding and engineering skills to create software and hardware products.

Product Manager
Defining the product vision and strategy. Communicating with the development team to have an accurate delivery of the complete product.

Skills: Technical Knowledge, Strategic Thinking, Communication, Analysis

Project Manager
A project is a temporary endeavour which has a clearly defined start and end, a set of activities and tasks, a budget and a specified business case.

Skills: Change and risk management, scheduling and time management, cost control and quality management.



University • Post and undergraduate

Technical Officer
Product Representative
Electrical Engineer
Hardware Developer
Systems Integrator
IT Project Consultant
Computer Systems Engineer
e-Commerce Specialist
Mechatronics Engineer
Project Manager
Robotics Engineer
Aerospace Engineer
Industrial Engineer
Software Architect
Software Developer
Games Developer
Programmer

Product Development

Design & develop hardware products & software applications

What type of career uses this knowledge?

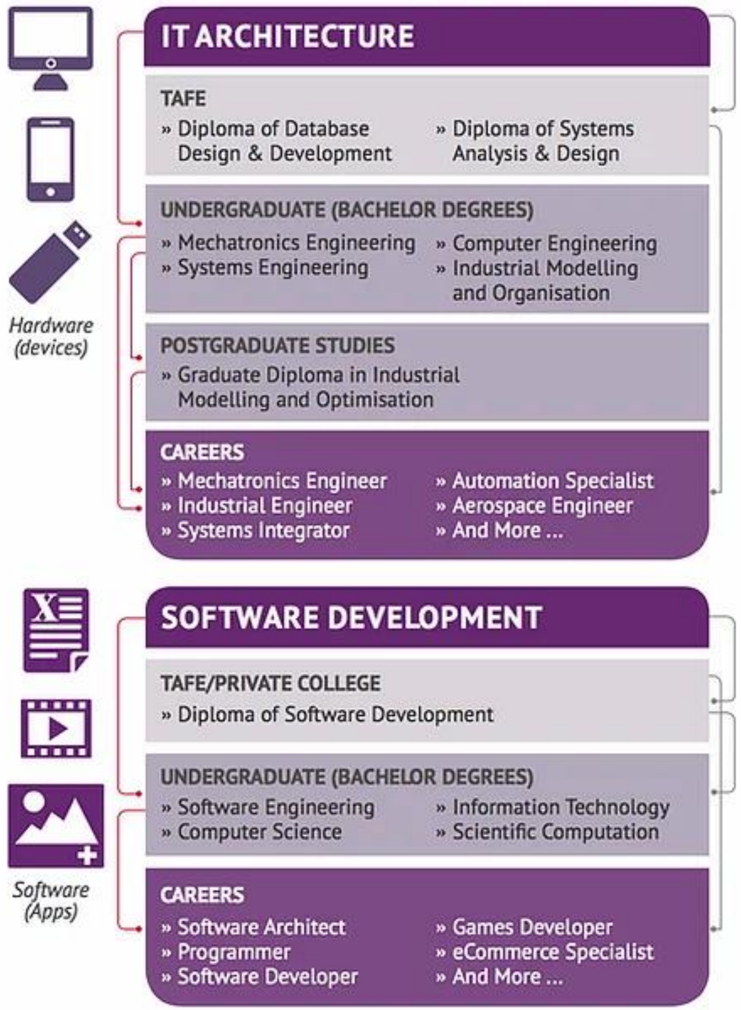
Product Manager

Source: https://youtu.be/5feQ1xReKrs

Project Manager

Source: https://youtu.be/GGT9aROtrlY

What type of career uses this knowledge?



Hardware (devices)

IT ARCHITECTURE

TAFE

- Diploma of Database Design & Development
- Diploma of Systems Analysis & Design

UNDERGRADUATE (BACHELOR DEGREES)

- Mechatronics Engineering
- Systems Engineering
- Computer Engineering
- Industrial Modelling and Organisation

POSTGRADUATE STUDIES

- Graduate Diploma in Industrial Modelling and Optimisation

CAREERS

- Mechatronics Engineer
- Industrial Engineer
- Systems Integrator
- Automation Specialist
- Aerospace Engineer
- And More ...

Software (Apps)

SOFTWARE DEVELOPMENT

TAFE/PRIVATE COLLEGE

- Diploma of Software Development

UNDERGRADUATE (BACHELOR DEGREES)

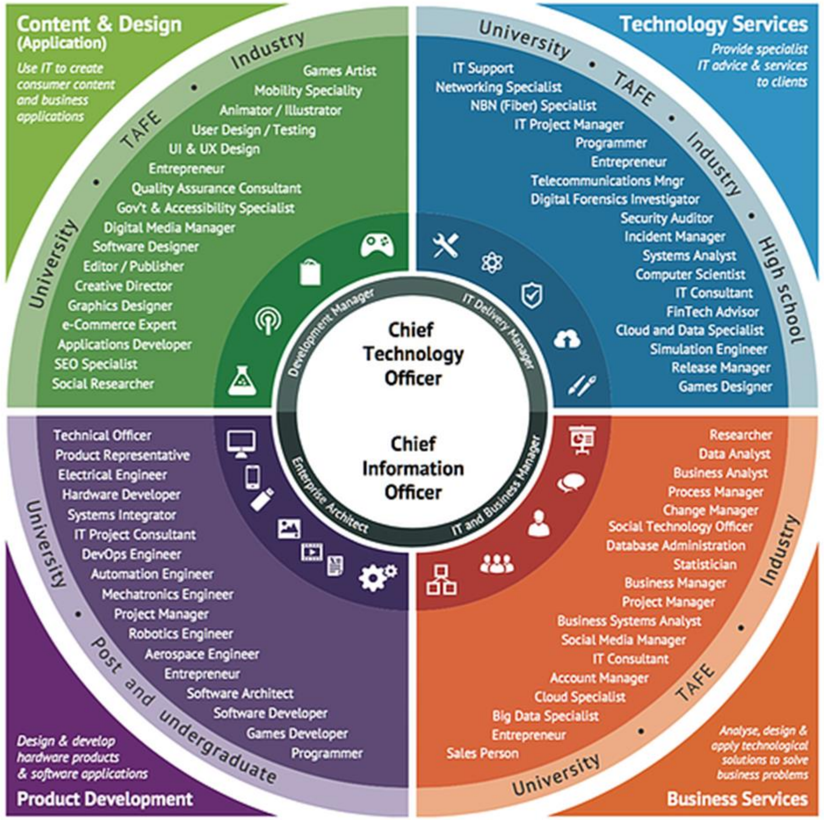
- Software Engineering
- Computer Science
- Information Technology
- Scientific Computation

CAREERS

- Software Architect
- Programmer
- Software Developer
- Games Developer
- eCommerce Specialist
- And More ...

The Jobs of the Future

ICT Career Wheel *for students*



Content & Design
(Application)

Use IT to create consumer content and business applications

Industry • TAFE • University

Games Artist
Mobility Speciality
Animator / Illustrator
User Design / Testing
UI & UX Design
Entrepreneur
Quality Assurance Consultant
Gov't & Accessibility Specialist
Digital Media Manager
Software Designer
Editor / Publisher
Creative Director
Graphics Designer
e-Commerce Expert
Applications Developer
SEO Specialist
Social Researcher

Technology Services

Provide specialist IT advice & services to clients

University • TAFE • Industry • High school

IT Support
Networking Specialist
NBN (Fiber) Specialist
IT Project Manager
Programmer
Entrepreneur
Telecommunications Mngr
Digital Forensics Investigator
Security Auditor
Incident Manager
Systems Analyst
Computer Scientist
IT Consultant
FinTech Advisor
Cloud and Data Specialist
Simulation Engineer
Release Manager
Games Designer

Development Manager
IT Delivery Manager

Chief Technology Officer

Chief Information Officer

Enterprise Architect
IT and Business Manager

Technical Officer
Product Representative
Electrical Engineer
Hardware Developer
Systems Integrator
IT Project Consultant
DevOps Engineer
Automation Engineer
Mechatronics Engineer
Project Manager
Robotics Engineer
Aerospace Engineer
Entrepreneur
Software Architect
Software Developer
Games Developer
Programmer

University • Post and undergraduate

Design & develop hardware products & software applications

Product Development

Researcher
Data Analyst
Business Analyst
Process Manager
Change Manager
Social Technology Officer
Database Administration
Statistician
Business Manager
Project Manager
Business Systems Analyst
Social Media Manager
IT Consultant
Account Manager
Cloud Specialist
Big Data Specialist
Entrepreneur
Sales Person

Industry • TAFE • University

Analyse, design & apply technological solutions to solve business problems

Business Services

High School
+
Tafe/Uni
+
Work Experience
=
Dream Job

The **secret ingredient** for landing your dream job is 'work experience'. When study is combined and integrated with an industry placement (such as an internship), more possibilities open up.

Definitions

Decision tree	A specific type of flow chart that visualises the decision-making process by mapping out different courses of action, as well as potential outcomes
Decompose	To separate a complex problem into parts to allow a problem to be more easily understood
Economic	Having to do with finance, business and the economy
Element	A component of a whole or part of a complete product
Environmental	Having to do with the man-made or natural environment or space within which a person is situated
Factor	A circumstance, fact, or influence that contributes to a result
Idea	A thought that is created to start the process of creating a solution (product) or process
Iteration	The repetition of a process in order to generate an outcome
Model	An idea made into a draft construction which will go through many iterations before becoming a product or solution
Problem	A matter that is needing to be dealt with and overcome (problems provide opportunities)
Social	Having to do with human interactions and relationships
Solution	A means of solving a problem or dealing with a difficult situation (systems thinking)
Technical	Having to do with technology use or application
Useability	Having to do with how easy and successful it is to use a product or process

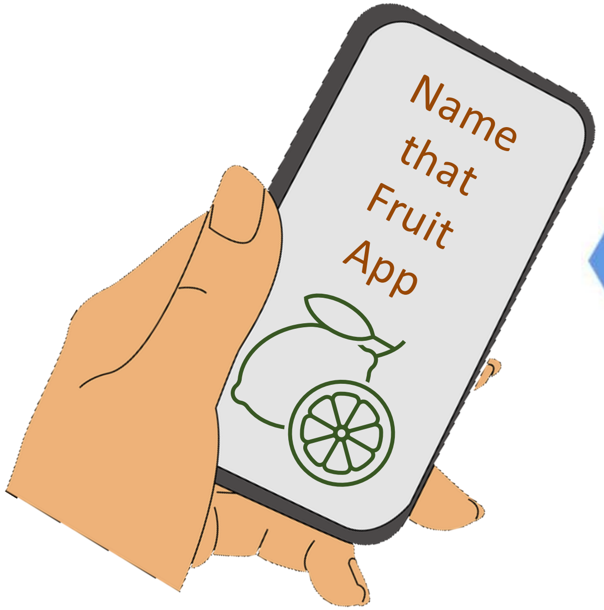
The Problem and Design Thinking Strategy

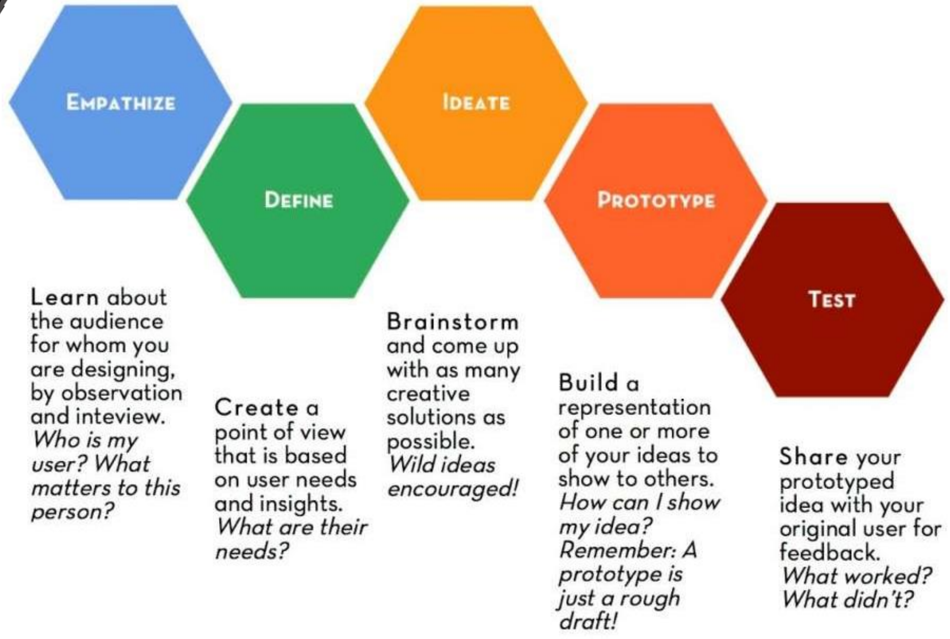
Apps are great! They sit on smart phones that have amazing technology inside – sensors, cameras, processors.

Technology is used to make life better and more efficient. Our quality of life should improve as technology advances.

Let's plan for an app that makes life better through healthy eating and calorie intake monitoring. The 'Name That Fruit' app can identify any fruit in the world and calculate its weight and calories.

Let's use Design Thinking and Computational Thinking to make a plan for the app.





Empathize

Learn about the audience for whom you are designing, by observation and inteview. *Who is my user? What matters to this person?*

Define

Create a point of view that is based on user needs and insights. *What are their needs?*

Ideate

Brainstorm and come up with as many creative solutions as possible. *Wild ideas encouraged!*

Prototype

Build a representation of one or more of your ideas to show to others. *How can I show my idea? Remember: A prototype is just a rough draft!*

Test

Share your prototyped idea with your original user for feedback. *What worked? What didn't?*

Image credit: Stanford d.school (2018)

Design Thinking: Empathise

We use Design Thinking to find solutions to problems and human needs. You need to understand how your users feel in order to provide a useful product.

Before we make our app:

Why is this app needed?

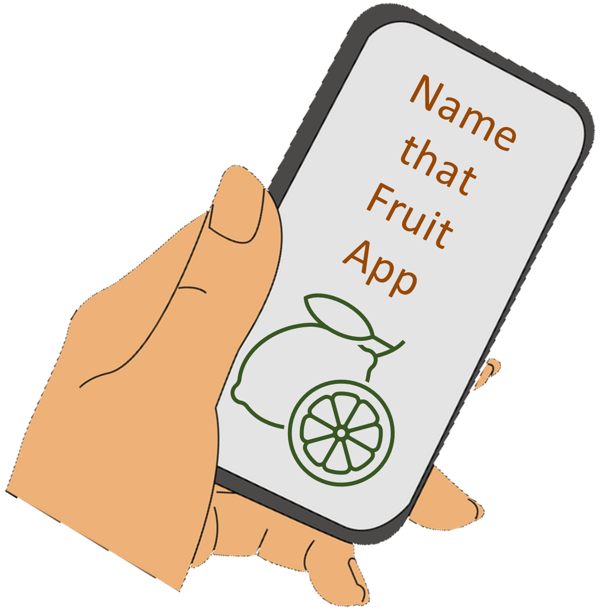
- Ascertain who your users are – farmers, gardeners, national parks rangers
- What are their challenges? What do they need from the app?

How can the app be of benefit to the world?

- Gather data through surveys and interviews to see if there is a need for the app

What experts do I need to help me with the app?

- Collaboration drives Design Thinking, bringing many diverse ideas



Design Thinking: Define

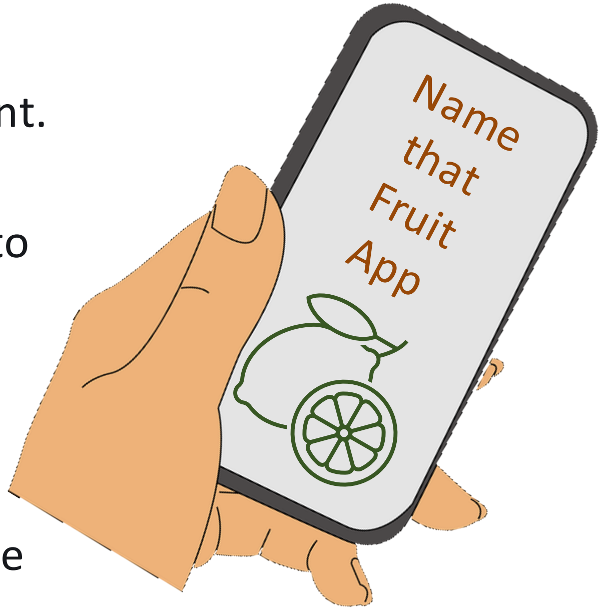
Get a clear understanding of what you are actually trying to achieve – define your problem with a problem statement. What are you solving?

What? Take your data from the empathise phase and define a clear problem statement.

Why? The problem statement determines the specific challenge you will solve. It will guide the entire design process moving forward, providing a goal upon which to focus on and centralising the user's needs.

How? Focus on the user's needs when creating the problem statement, rather than those of the business. Make it human-centered, specific enough for clear direction but general enough for creativity.

Example "People who are travelling, watching what they eat or have allergies need to be able to identify what they are about to eat and how many calories are in the fruit they are eating" is more user-centric than "I need make a cool app that will make me lots of money."



Design Thinking: Ideate

Referring to the problem statement, produce as many ideas and solutions as possible.

In your group, there is a safe environment where all team members can contribute ideas which are evaluated with empathy and not rejected without consideration.

Include different stakeholders in your ideation sessions. Keep referring to your problem statement and surface as many ideas as possible.

There are many questions to answer:

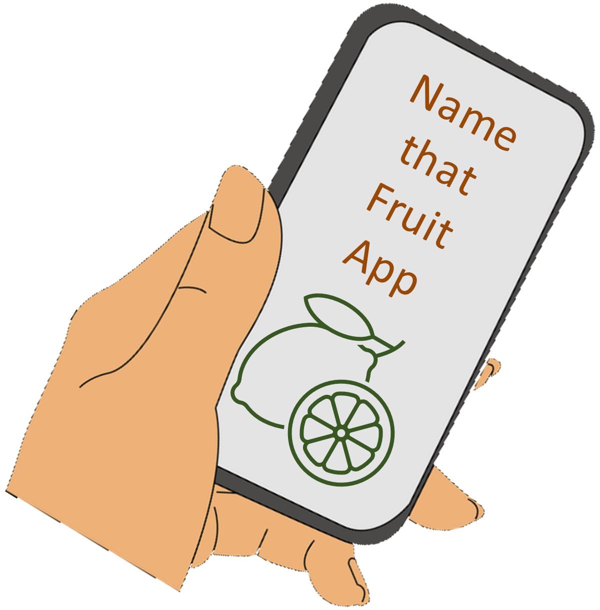
- What exactly do we want the app to do?
- Are there any apps like this already?
- What are the environmental considerations?
- What will the app do once a fruit is identified?
- What are the ethical considerations?
- What technology do we need to use?
- How will the algorithm work?
- Will there be any accessibility issues for people with vision and hearing impairment, or physical disabilities?
- What ages can use the app?
- What languages will you include for the instructions?
- What considerations will there be for the user interface?

Design Thinking: Prototype

Prototyping means that you make simple models (MVPs – minimum viable products) that can be tested with focus groups and real users.

Prototypes can take various forms. New technologies like 3D printing and Virtual Reality make prototyping much easier and more realistic than traditional methods. Using these tools allows for Rapid Prototyping.

For our app, we need a combination of software, hardware and algorithms. An algorithm is a series of steps, like the Method in a Recipe. A good way to plan for the steps needed in a successful process is to make a Decision Tree!



Decision Tree

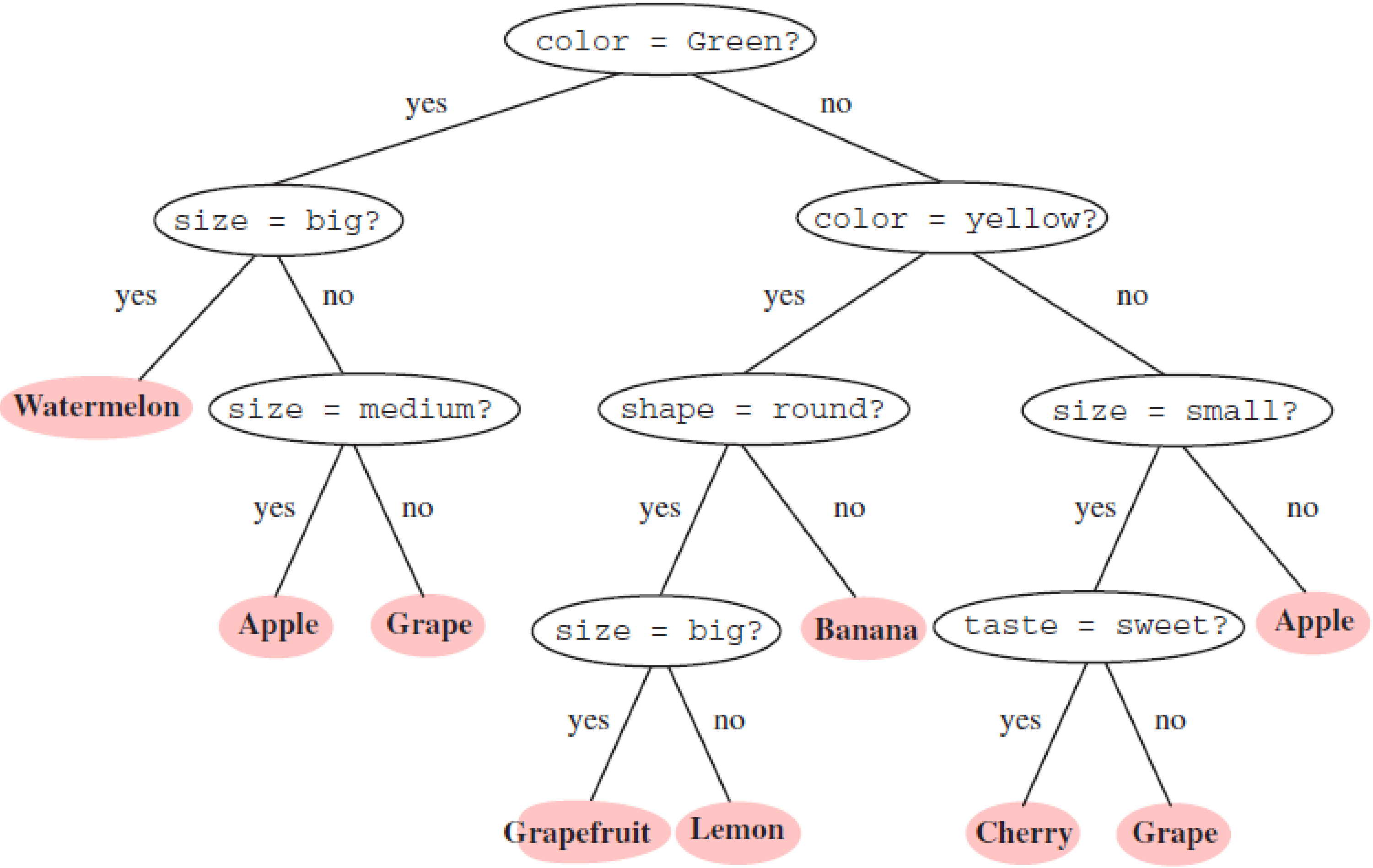
A decision tree is like a flowchart. It is a support tool for decision–making that uses a tree-like model of choices and their possible consequences.

It is a popular way to display an algorithm that only contains simple decisions such as true or false, or yes and no.

This decision tree shows how your app should work to determine the common fruit.

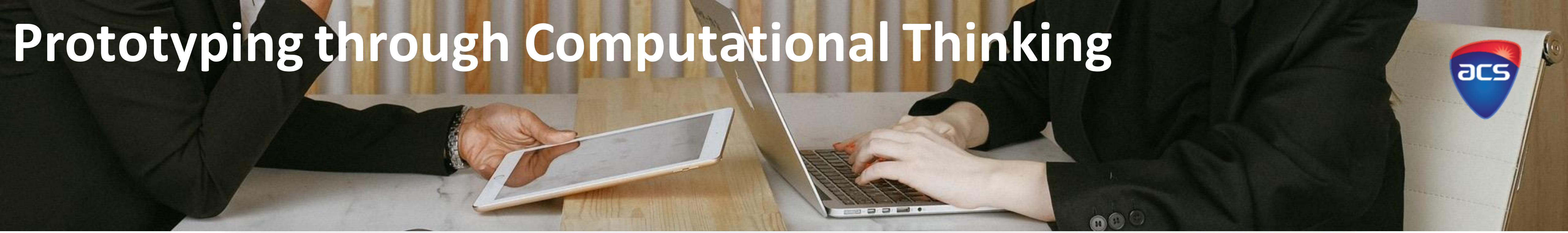
Simple questions are asked based on attributes of the fruit. The answer is either ‘yes’ or ‘no’.

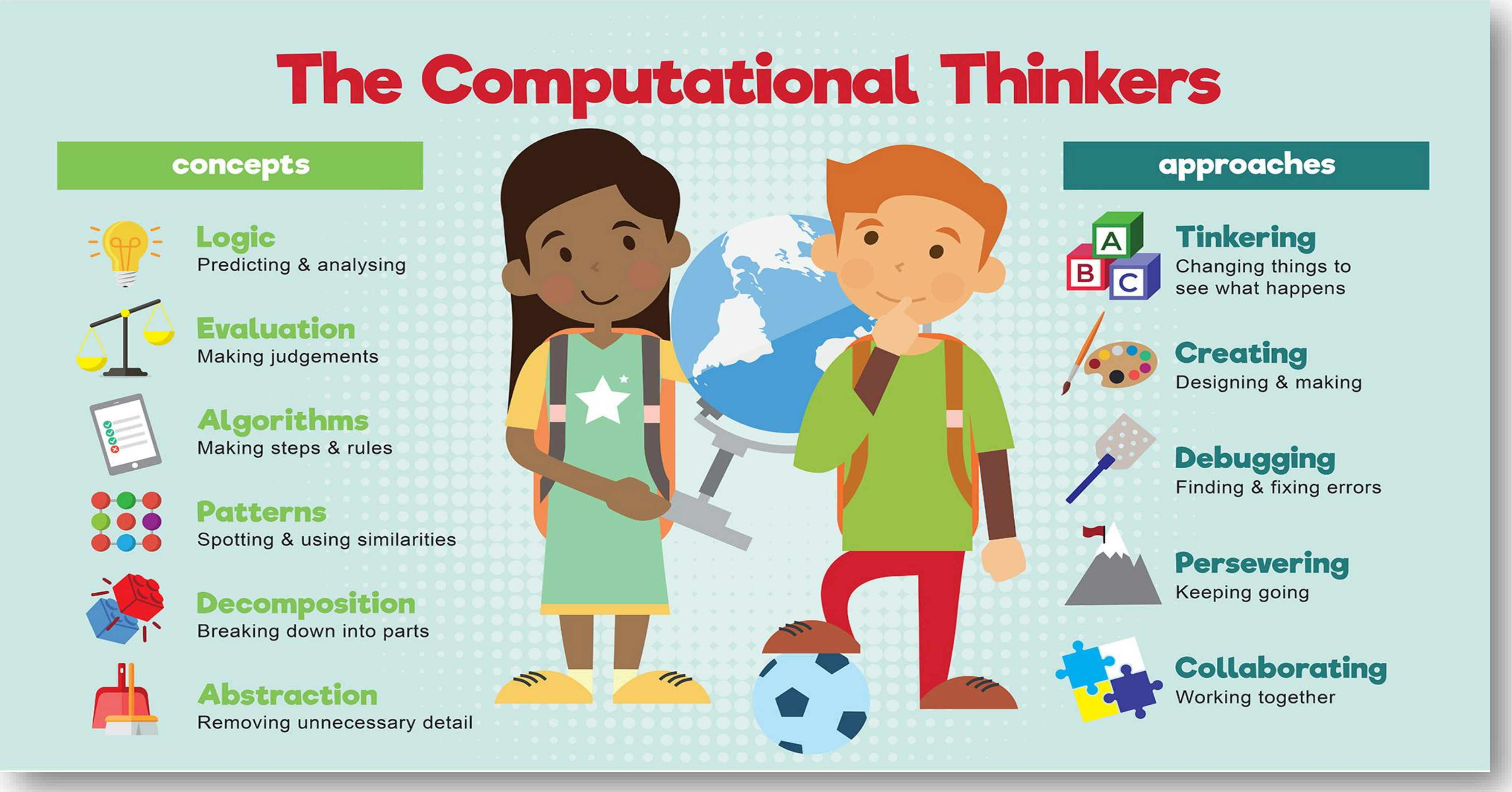
Let’s see how Algorithms fit in the Computational Thinking process.



color = Green?
yes
no
size = big?
color = yellow?
yes
no
yes
no
Watermelon
size = medium?
shape = round?
size = small?
yes
no
yes
no
yes
no
Apple
Grape
size = big?
Banana
taste = sweet?
Apple
yes
no
yes
no
Grapefruit
Lemon
Cherry
Grape

Prototyping through Computational Thinking





The Computational Thinkers

concepts

Logic
Predicting & analysing

Evaluation
Making judgements

Algorithms
Making steps & rules

Patterns
Spotting & using similarities

Decomposition
Breaking down into parts

Abstraction
Removing unnecessary detail

approaches

Tinkering
Changing things to see what happens

Creating
Designing & making

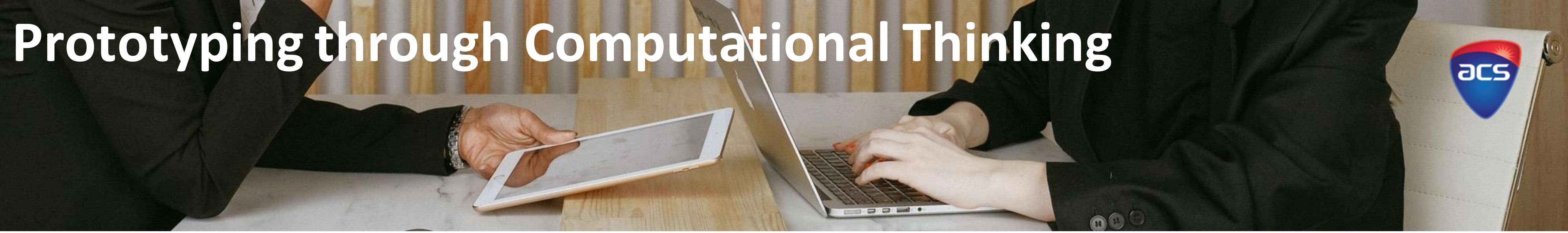
Debugging
Finding & fixing errors

Persevering
Keeping going

Collaborating
Working together

Image credit: Barefoot Computing

Prototyping through Computational Thinking



Computational thinking is a skill that we use to understand a complex problem and develop possible solutions. Computational Thinking has four key techniques that occur in this order:

Decomposition – separate a problem or system into smaller, more manageable elements

Pattern recognition – looking for similarities within problems to solve problems more efficiently

Abstraction – ignoring unimportant details and only focusing on the critical information

Algorithms – creating a logical, step-by-step solution or the rules to follow in order to solve the problem

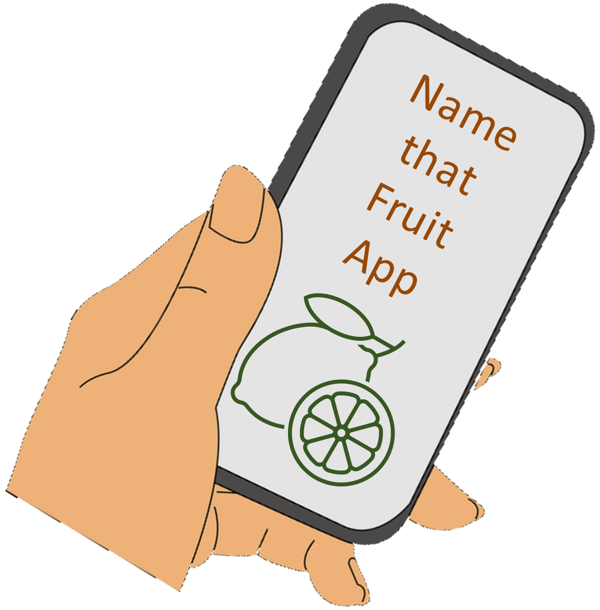
Correct application of each technique is as important when programming a computer. If one is left out, the process will not work. All elements are as important as each other. A software developer will need to use Computational Thinking to successfully prototype and create an app.

Design Thinking: Test

Now that you have done your research, identified the problem, collaboratively worked to come up with ideas and made some prototypes, you need to test your product.

Testing allows you to see where your prototype works and where it needs to be improved. User feedback gives you the data to understand where to make improvements before you develop the finished product or solution.

In this phase, user testing sessions allow observations of people using your prototype. Verbal, written and anecdotal feedback through the testing phase will give you even more ideas for the next iteration of your product.



Technical Advisor

David Beitey *is an IT Industry Professional with a Bachelor of Information Technology (Honours). David is currently the Online Technologies Manager at the eResearch Centre at James Cook University. His experience lies in full stack web and application development, user experience, systems administration and integration, project management and business analysis.*

David is an organiser of the DevNQ (Developers North Queensland) community and active open source software developer. He regularly mentors students, researchers and colleagues, and has previously been involved in the CSIRO STEM Professionals in Schools, a national volunteer program that partners schools and industry to bring STEM (Science, Technology, Engineering and Maths) experiences into the classroom.

David's expertise and oversight has guided the publication of the resource and the ACS thanks David for his partnership in the ICT Gateway to Industry Schools program.

Founder & Principal Coach - BIGJUMP

Joeri (Yuri) Timmermans has over 20+ years' experience in the technology industry and has delivered many large complex business and technology projects and programs.

He has spent his entire career helping corporates and other organisations innovate and transform to become more agile by closing the gap between business and technology that provides them with a competitive advantage or ability to make a difference.

Acknowledgements

About ACS

ACS is the professional association for Australia's technology sector. More than 48,000 ACS members work in business, education, government and the community. ACS exists to create the environment and provide the opportunities for members and partners to succeed.

ACS strives for technology professionals to be recognised as drivers of innovation in our society, relevant across all sectors, and to promote the formulation of effective policies on technology and related matters. Visit www.acs.org.au for more information.

About the ICT GISP

The Information and Communications Technology Gateway to Industry Schools program encourages partnerships between industry, government, schools and their communities to build Queensland's future information technology workforce. The program provides an important opportunity to address the significant shortfall of young, emerging ICT talent in Queensland. Access more information and ICT teaching resources below:

ICT GISP Website - https://qldictgisp.acs.org.au/home.html

ICT Educators Community of Practice - https://www.acs.org.au/ict-educators.html

The Big Day In ICT Careers - https://www.thebigdayin.com.au/

ICT Careers Wheel - https://qldictgisp.acs.org.au/career-pathways.html

The Department of Employment, Small Business and Training funds this Gateway to Industry Schools Program initiative

Acknowledgements

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