**Sample Course Outline**

Computer Science

ATAR Year 12

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# Sample course outline

# Computer Science – ATAR Year 12

## Unit 3: Design and development of programming and networking solutions

| **Week** | **Syllabus Content** |
| --- | --- |
| **Knowledge** | **Skills** |
| 1 | **Course introduction*** overview of Unit 3
* assessment requirements

**Programming****Good programming practice**Framework for development* investigate
	+ problem description
	+ define requirements
	+ development schedule (including Gantt charts)
* design
	+ design data structures
	+ design and test algorithm
* develop
	+ develop and debug code
	+ unit testing and use of live data
* evaluate
	+ user acceptance testing
	+ developer retrospective
* compare common development processes
	+ linear
	+ iterative
* good programming practice, including:
	+ validate input before processing
	+ a clear and uncluttered mainline
	+ one logical task per subroutine
	+ use of stubs
	+ appropriate use of control structures and data structures
	+ writing for subsequent maintenance
	+ version control
	+ regular backup
	+ exception handling
	+ functions are able to return a single data structure or value
 |  |
| 2–3 | **Programming skills and concepts*** program control structures, including:
	+ sequence
	+ selection
	+ iteration
		- post-test
		- pre-test
* characteristics of data types used in solutions, including:
	+ integer
	+ float
	+ string
	+ Boolean
* modular coding using functions, parameters and arguments
	+ scope of variables (Global, Local)
* characteristics of the following data structures:
	+ arrays:
		- one-dimensional arrays
		- two-dimensional arrays
	+ dictionaries
 | **Programming skills and concepts*** apply, using pseudocode and a programming language, program control structures in solutions
* apply, using pseudocode and a programming language, data types used in solutions as variables
* apply, using pseudocode and a programming language, modular coding using functions, parameters and arguments
* use different types of operators
	+ arithmetic operators (+, -, \*, /, %)
	+ relational operators (==, !=, >, =, <=)
	+ logical operators (AND, OR, NOT)
* reading and writing of complex logical expressions including:
	+ Boolean operators (AND, OR, NOT)
	+ logical order of precedence
* apply, using pseudocode and a programming language, the following data structures:
	+ arrays:
		- one-dimensional arrays
		- two-dimensional arrays
* dictionaries

**Good programming practice*** apply common development processes
* apply good programming practice when developing a software solution, including:
	+ validate input before processing
	+ a clear and uncluttered mainline
	+ one logical task per subroutine
	+ use of stubs
	+ appropriate use of control structures and data structures
	+ writing for subsequent maintenance
	+ version control
	+ regular backup
	+ recognition of relevant social and ethical issues
	+ exception handling
	+ functions return a single data structure or value
 |
| 4–5 | **Structured algorithms*** effective structure of code
	+ use of a modular approach, including functions and classes
	+ use of stubs to represent incomplete modules
	+ parameter passing
* common algorithms:
	+ Big O notation
	+ search algorithms
		- linear search
		- binary search
	+ sort algorithms:
		- bubble sort
		- insertion sort
		- selection sort
 | **Structured algorithms*** use pseudocode and/or programming language for representing algorithms
* create code with effective structure
	+ use of a modular approach, including functions and classes
	+ parameter passing
	+ use of stubs to represent incomplete functions
 |
| 6–7 | **Testing*** acceptance testing of functional requirements based on user needs
* the use of live test data to ensure that testing accurately reflects the expected environment in which the new system will operate
	+ large file sizes
	+ mix of transaction types
	+ response times
	+ volume of data (load testing)
* validation of the solution with the design specifications
* generating relevant test data for complex solutions
* comparison of actual with expected output
* unit tests to ensure code performs correctly

**Error detection and debugging code*** the process of detecting and correcting errors, including:
	+ types of error
		- syntax errors
		- logic errors
		- runtime errors, including:
			* arithmetic overflow
			* division by zero
			* index out of range
	+ methods of error detection and correction
		- methodical approach to the isolation of logic errors
		- use of debugging techniques
			* breakpoints
			* print statements
		- desk checking (trace tables)
		- comparison of actual with expected output
 | **Testing*** comparison of the solution with the design specifications
* generating relevant test data for complex solutions
* comparison of actual with expected output

**Error detection and debugging code*** the process of detecting and correcting errors, including:
	+ types of error
		- syntax errors
		- logic errors
		- runtime errors, including:
			* arithmetic overflow
			* division by zero

index out of range * + methodical approach to the isolation of errors
		- use of debugging techniques
			* breakpoints
			* print statements
		- desk checking (trace tables)
		- comparison of actual with expected output
 |
| 8 | **Object-oriented programming*** characteristics of the following object-oriented concepts:
	+ classes
	+ objects
	+ attributes
	+ methods
	+ abstraction and polymorphism
	+ instantiation
	+ inheritance
	+ encapsulation
 | **Object-oriented programming*** apply, using pseudocode and programming language, object-oriented programming concepts, including:
	+ classes
	+ objects
	+ attributes
	+ methods/operations
	+ abstraction
	+ instantiation
	+ inheritance
* use an object-oriented programming language to:
	+ create classes and objects with attributes and methods.
	+ instantiate objects
	+ use inheritance to extend classes
	+ use variables and control structures within objects
 |
| 9–10 | **Ethical and legal implications for developers of software*** impacts of software in society, including:
	+ computer malware, such as viruses
	+ reliance on software
	+ social networking
	+ cyber safety
	+ large volumes of information (which may be unsupported, unverifiable, misleading or incorrect) available through the internet
* rights and responsibilities of software developers
	+ acknowledging the intellectual property of others
	+ recognition by others of the developer’s intellectual property
	+ producing quality software solutions
	+ appropriately responding to user-identified problems
	+ adhering to code of conduct
	+ neither generating nor transmitting malware
	+ addressing ergonomic issues in software design
	+ ensuring software addresses inclusivity issues
	+ ensuring individuals’ privacy is not compromised
* concepts associated with piracy and copyright law in relation to software development in Australia
 |  |
| 11–12 | **Networking Communications****Models of networking*** comparison between the Open Systems Interconnection (OSI) Model and the Department of Defence (DoD) transmission control protocol/internet protocol (TCP/IP) model
* OSI model:
	+ purpose of OSI model
	+ layers of OSI model
	+ role of layers within the model
	+ MAC address layer 2 switching
	+ IP address layer 3 routing
* DoD TCP/IP model:
	+ purpose of DoD model
	+ layers of DoD model
		- application
		- transport
		- internet
		- network
	+ role of layers within the model
* key protocols and devices associated with layers in models
	+ user datagram protocol (UDP)
	+ difference between UDP and TCP
	+ compare packet architecture between TCP and UDP
* features of TCP/IP
	+ IPv4 vs IPv6
	+ IP Addressing
	+ private vs Public IP addressing
	+ subnet masks
	+ subnetting
	+ default gateways
	+ domain name system (DNS)
	+ ports
	+ packet architecture
		- data
		- segment
		- packet
		- frame
		- bits
 | **Models of networking*** identify, design and apply IP addressing scheme
* identify, design and apply subnet masks
 |
| 13–14 | **Network components*** role of components at different network layers
	+ transmission media
	+ router
	+ gateway
	+ switch
	+ wireless Access Point
	+ firewalls

**Network performance*** network design topology for security and performance
* bandwidth
	+ mapping networks using diagrams including intermediary and end devices
	+ subnetting and collision domains (segmentation)
* tools for network performance management and troubleshooting
	+ ping
	+ traceroute
 | **Network performance*** use ping and traceroute to troubleshoot and evaluate network performance
* interpret and create network diagrams using specified CISCO conventions to represent network topologies, considering addressing, subnets, segmentation, security and performance
 |
| 15 | Revision |
| 16 | Semester 1 Examination |

## Unit 4: Design and development of database solutions and cyber security considerations

| **Week** | **Syllabus Content** |
| --- | --- |
| **Knowledge** | **Skills** |
| 1–2 | **Course introduction*** review of Unit 3
* overview of Unit 4
* assessment requirements

**Cyber Security****Network threats*** external Network Threats
	+ social engineering (phishing)
	+ denial of service, including distributed denial of service
	+ back door
	+ IP spoofing
	+ SQL Injection
	+ man-in-the-middle
	+ cross-site scripting
	+ types of malware
	+ physical network threats
	+ zero day vulnerabilities
* internal network threats
	+ lost or stolen devices
	+ compromised credentials
	+ misuse by employees
* security solutions to network threats
	+ analysis of log files
	+ anti-malware
	+ firewall filtering
	+ access control lists
	+ intrusion prevention systems
	+ virtual private networks
	+ user training
	+ ICT code of conduct
	+ physical security
* appropriate solutions to different external network threats
 | **Network threats*** identify network security threats and suggest solutions for a given stimulus (mitigation strategies)
 |
| 3 | **Cryptography*** symmetric encryption
* asymmetric encryption (public/private keys)
	+ certificate purpose and use
* use of asymmetric encryption to:
	+ prevent unauthorised access to data
	+ authenticate data being sent across network
* secure communication over the Internet:
	+ use of asymmetric encryption to establish connection and symmetric encryption to exchange data
* common methods of encryption:
	+ early methods and weaknesses
	+ current best practice

**Ethics and Law*** the *Privacy Act 1988* as it relates to data security Australian Privacy Principle 11 (APP11)
* the *Privacy Amendment (Notifiable Data Breaches) Act 2017*
 | **Ethics and Law*** apply theoretical ethics and law knowledge using supplied case studies
 |
| 4–5 | **Ethical Hacking*** role of ethical hacking in improving network security
* penetration testing: role of blue team vs red team

**Data Management****Core concepts*** organisation of a relational database:
	+ entities
	+ attributes
	+ relationships:
		- one-to-one
		- one-to-many
		- many-to-many
	+ tables as the implementation of entities, consisting of fields and records
	+ data types
		- integer
		- float
		- Boolean
		- text
		- date
* primary and foreign keys to link tables
* composite key
* data anomalies:
	+ insert
	+ update
	+ delete
* how databases interact with other systems and link to the programming content
	+ open database connectivity
* role of ACID in database transactions – atomicity, consistency, isolation, durability
 |  |
| 6–8 | **Data modelling*** purpose of database documentation for the developers
	+ data dictionary
	+ Entity Relationship (ER) diagrams using crow’s foot notation

**Data integrity** * data integrity:
	+ referential integrity
	+ domain integrity
	+ entity integrity
* factors influencing quality of data, including:
	+ currency
	+ authenticity
	+ relevance
	+ accuracy
	+ outliers (cleaning)
 | **Data modelling*** analyse ER diagrams written in crow’s foot notation (three to 10 tables)
* create accurate ER diagrams using crow’s foot notation (three to eight tables)
* represent databases using relational notation)
* create data dictionaries
* resolve many-to-many (M:N) relationships
 |
| 9–10 | **Normalisation*** purpose of normalising data to third normal form (3NF)
	+ rules of 1NF
	+ rules of 2NF
	+ rules of 3NF
* know the process to normalise data to 3NF
 | **Normalisation*** apply the process to normalise data to 3NF using relational notation
 |
| 11–13 | **Database creation and manipulation*** know techniques to retrieve required information through querying data sets, including:
	+ searching, sorting and filtering to identify relationships and patterns
	+ cleaning and manipulating data sets to import required data into a database
 | **Database creation and manipulation*** use a relational database management system (RDBMS) to create and manipulate a relational database with a minimum of five tables.
* use SQL to create, modify and manipulate a database including:
	+ CREATE and MODIFY tables, including:
		- use of constraints to ensure validity of data
		- enforcing referential integrity
	+ DROP
	+ SELECT
	+ INSERT
	+ UPDATE
	+ DELETE, including cascading deletes
	+ aggregate functions (COUNT, SUM, AVG, MAX, MIN)
	+ ORDER BY
	+ inner join across multiple tables (up to 4 tables)
	+ GROUP BY (with aggregate functions)
	+ calculated fields
	+ concatenated fields
	+ use of aliases with calculated and concatenated fields
* apply techniques to retrieve required information through querying data sets, including:
	+ searching, sorting and filtering to identify relationships and patterns
	+ cleaning and manipulating data sets to import required data into a database
 |
| 14 | **Development issues*** ethical issues:
	+ collecting data about individuals
	+ privacy concerns
	+ appropriate use of data
	+ reliability of data sources
	+ acknowledgement of data sources
	+ use of data mining
* security issues:
	+ keeping personal data private
	+ backups of organisational data
	+ restricting access to data
	+ ownership and control of data
* legal issues
	+ Australian privacy law in relation to database development
	+ Australian Privacy Principles (APP5, APP8, APP10, APP11, APP12)
 |  |
| 15 | Revision |  |
| 16 | Semester 2 Examination |  |