Stony Point High School
IB Diploma Programme
Course Syllabus

IB Computer Science HL

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Tutorial Hours: Monday 8:30-9:00 AM and Tuesday 4:30 - 5:00 PM

I. **Course Description:** IB Comp Sci SL (3923), IB Comp Sci HL (3932)
Computer science requires an understanding of the fundamental concepts of computational thinking as well as knowledge of how computers and other digital devices operate.

II. **Prior Learning for Course**: ***Prerequisite(s): AP Computer Science Principles for SL. AP Computer Science Math for HL. Prefer Computer Science III for HL.***
This single-period course examines advanced topics such as discrete mathematics, circuit design, dynamic data structures, algorithm efficiency and client-oriented software development.

III. **IB Diploma Programme (DP) Computer Science HL Course Description and Aims:**

The IB DP computer science HL course requires an understanding of the fundamental concepts of computational thinking as well as knowledge of how computers and other digital devices operate. The course, underpinned by conceptual thinking, draws on a wide spectrum of knowledge, and enables and empowers innovation, exploration and the acquisition of further knowledge. Students study how computer science interacts with and influences cultures, society and how individuals and societies behave, and the ethical issues involved. During the course, the student will develop computational solutions.

This will involve the ability to:

- identify a problem or unanswered question
- design, prototype and test a proposed solution
- liaise with clients to evaluate the success of the proposed solution and make recommendations for future developments.
- demonstrate initiative in applying thinking skills critical to identify and resolve complex problems

- engender an awareness of the need for, and the value of, effective collaboration and communication in resolving complex problems
- develop logical and critical thinking as well as experimental, investigative and problem-solving skills
- develop and apply the students' information and communication technology skills in the study of computer science to communicate information confidently and effectively
- raise awareness of the moral, ethical, social, economic and environmental implications of using science and technology
- develop an appreciation of the possibilities and limitations associated with continued developments in IT systems and computer science
- encourage an understanding of the relationships between scientific disciplines and the overarching nature of the scientific method.

IV. How the course will address TOK:

During the course in computer science a number of issues will arise that highlight the relationships between theory of knowledge and computer science. Some of the questions that could be considered during the course are identified in the following list.

• What is the difference between data, information, knowledge and wisdom? To what extent can computers store and impart data, information, knowledge and wisdom?

• Computational thinking includes: procedure, logic, pre-planning (thinking ahead), concurrency,abstraction and recursion. To what extent are these ways of thinking distinct? To what extent can knowledge in different areas (mathematics, ethics, and so on) be analyzed in these ways?

• It has been said that human memory is more like an improvised performance than a movie on a DVD. What does this mean? How does human memory differ from computer memory?

• How does a computer language differ from a natural language?

• What are the differences between representing numbers in denary and in binary? In binary, 1 + 1 = 10. Does this tell us anything about the nature of mathematical truth?

• What are the challenges of creating a computer model of some aspect of the world?

• A chess machine can beat the top human chess players. Does a machine therefore "know" how to play chess?

V. How the course will address CAS: Creativity, activity, service involves students in experiential learning through a range of artistic, sporting, physical and service activities. One example of CAS in Computer Science is our voluntary hosting of a community webpage for the game "Breakout." This page allows students to showcase their work to peers and the community. The game theme is about how their team will cure the disease. Other opportunities to link Computer Science to CAS might include developing websites, software, and/or social media for various clients within the SPHS community, or using one's coding skill to assist a community non-profit organization.

VI. How the course will address Approaches to Learning skills :

- **Thinking skills** (introducing a problem: discuss as a class; think out loud activity)
- **Communication skills** (writing, presenting, and documentation of work)

- **Social skills** (working peers; evaluations and peer review of work)
- **Self-management skills** (working with critiques and comments about coding or projects)
- **Research skills** (working with a subject matter and sharing with others)

VII. How the course will address the Learner Profile. Students can expect lectures that will have real world applications. In classwork labs that will focus on conceptual understanding, such as working with a flowchart to outline coding a program. Collaborative projects will be vital because students will show teamwork. Assessments are monitored for grasping the learning objectives. Examples will be used from previous papers for students to practice and be tested.

The computer science syllabus is closely linked to the IB learner profile. The computer science syllabus allows students to address all the attributes of the IB learner profile. For each attribute of the learner profile, a number of examples selected from the computer science syllabus are given below.

Learner profile attribute	Computer Science
Thinkers	Content: HL extension, formulating strategic plans in case study. Solution: Develop an extensible product so it can be maintained by others.
Reflective	Content: Case study, reflecting impossible decisions related to a strategic decision. Solution: Evaluate methodologies used to develop products to recommend future improvements.
Inquirers	Content: SL/HL core, HL extension, case study. Decomposing systems to find underpinning algorithms. Solution: Investigation into appropriate scenarios.
Principled	Content: SL/HL core, HL extension, case study. Proposing solutions that are ethical and legal. Solution: Test the product to ensure it is error free and secure, protect any sensitive data.
Caring	Content: SL/HL core, HL extension, case study. Considering the opinions of different stakeholders when reaching a decision. Solution: Liaise with client, reach consensus in development of product.
Balanced	Content: SL/HL core, HL extension in analysis and judgment-type questions. Solution: Collection of data and the subsequent analysis and synthesis of the information to determine the most appropriate product.
Risk-takers	Content: Case study, formulate strategic plans.

	Solution: Make and justify decisions about which techniques to use in developing the most appropriate product.
Open-minded	Content: SL/HL core, HL extension, case study. Respecting differing cultures and opinions of others. Solution: Evaluate potential sources of information in terms of reliability, bias, relevance and accuracy.
Communicators	Content: SL/HL core, making links to theory of knowledge. Solution: Liaise appropriately with client and/or adviser to develop product that meets their requirements.
Knowledgeable	Content: SL/HL core, HL extension, case study. Solution: Justify appropriate techniques in developing the product or modifying an existing product.

VIII. Assessment details for Internal and External Requirements

SL: external assessment weight 70% and internal assessment 30%

Assessment Component	**Overall Weighting (%)**	**Approximate weighting of objectives(%)**				**Duration**
		1	**2**	**3**	**4**	
Paper 1	45	24	13	8	n/a	1 hour 30 mins
Paper 2	25	13	7	5	n/a	1 hour
Internal Assessment	30	9	8	4	9	30 hours

HL: external assessment weight 80% and internal assessment 20%

Assessment Component	**Overall Weighting (%)**	**Approximate weighting of objectives(%)**				**Duration**
		1	**2**	**3**	**4**	
Paper 1	40	21	12	7	n/a	2 hours 10 mins

Paper 2	20	10	6	4	n/a	1 hour 20 mins
Paper 3	20	9	7	4	n/a	1 hour
Internal Assessment	20	6	5	3	6	30 hours

The internal assessment requirements at SL and at HL are the same. However, these requirements contribute to a different percentage of the overall mark. Students are required to produce a solution that consists of a cover page, the product and the documentation. The focus of the solution is on providing either an original product or additional functionality to an existing product for a client.

The internal assessment component (solution), as well as being practical and productive, forms an important part of the assessment of the computer science course. It is imperative, therefore, that students practice some problems from previous papers.

Summary of the internal assessment task
30 hours of class time
individual collaboration with specified client/advisor
individual documentation
2,000 words (maximum)
marked by the teacher
externally moderated
30% of total marks for SL; 20% of total marks for HL

General overview of Internal assessment criteria

The computer science internal assessment focuses on the balance between the level of algorithmic thinking and problem-solving required to develop a product within the framework of the design cycle.

The assessment criteria

Criteria A, B and E are process-oriented and examine how the internal assessment task was carried out and allow common assessment criteria to be applied to different types of product from the different options. Criterion C is a holistic assessment of the final product and assesses

the student's understanding of the concepts involved in its development. Criterion D is a holistic assessment of the functionality and future extensibility of the product.

Criteria A: Planning	Criteria B: Solution overview	Criteria C: Development	Criteria D: Functionality and extensibility of product	Criteria E: Evaluation	Total
6 (17.66%)	6(17.66%)	12 (35%)	4(12%)	6(17.66%)	34(100%)

Criterion A: Planning: The success criteria identified in criterion A will be used in criterion D to evaluate the effectiveness of the product.

Criterion B: Solution overview: The student must provide a record of tasks and a design overview that includes an outline test plan. The *Record of tasks* form must be used. The record of tasks and design overview must refer to the product proposed in criterion A.

Criterion C: Development: The student must identify techniques used in developing the product. The student must explain the techniques, with screenshots, that were used to develop the product identified in criterion A, explaining why they have been used and why they are adequate for the task.

Criterion D: Functionality and extensibility of product:This criterion assesses the extent to which the product: 1)functions, as evidenced in the video 2)can be expanded and modified by future users as evidenced in the design and development documentation.

Criterion E: Evaluation: The student must evaluate the effectiveness of the product based on feedback from the client/adviser. This must include direct references to the success criteria identified in criterion A. The student must recommend proposals for the future improvement of the product.

IX. Grading Policy & Scale:

IB Computer Science class is weighted on a 6.0 scale.

Unit Assessments/Projects:

We have weighted grades of:

60% formative assessments include code challenges, notes, daily assignments

40% summative assessment include tests and quizzes

Each unit will contain periodic, short-answer quizzes, exams, and programming projects that allow students to demonstrate their mastery of course topics.

Supplemental Topic Quizzes

Throughout the year, students will independently research 32 weekly topics that directly or indirectly relate to the main course units. During most "Academic" Flex periods, students will be asked to answer short prompts from the weekly topics studied to date. Each quiz will contain 1 definition and 1 prompt from the current week's topic and 1 definition and 1 prompt from an earlier week (cumulative from the beginning of the year).

Code Challenges

These are short programming prompts that are to be completed within the span of a single class period. For each code challenge, students will write a short program to read and parse data from a text file, process the data according to the prompt, and then print the required output to the console. Submitted solutions will be judged for correctness of output, but not for efficiency. Students will receive immediate feedback indicating whether the solution is correct or incorrect. Incorrect solutions may be modified and resubmitted as many times as necessary until correct.

X.

XI. Course Sequence:

Syllabus component	Teaching hours	
	SL	HL
Core syllabus content		
SL/HL core The topics that must be studied, including some practical work, are: • Topic 1: System fundamentals (20 hours) • Topic 2: Computer organization (6 hours) • Topic 3: Networks (9 hours) • Topic 4: Computational thinking, problem-solving and programming (45 hours)	80	80
HL extension The topics that must be studied, including some practical work, are: • Topic 5: Abstract data structures (23 hours) • Topic 6: Resource management (8 hours) • Topic 7: Control (14 hours)	---	45
Case study Additional subject content introduced by the annually issued case study	---	30
Option		
SL/HL core	30	30
HL extension Students study one of the following options: Option A: Databases Option B: Modelling and simulation Option C: Web science Option D: Object-oriented programming (OOP)	---	15
Internal assessment		
Solution Practical application of skills through the development of a product and associated documentation	30	30
Group 4 project	10	10
Total teaching hours	**150**	**240**

XII. IA Checkpoint dates and final IA Deadlines: Failure to meet checkpoints will be communicated with the IB coordinator. All checkpoint submissions will be turned in electronically on the date listed below, regardless of A/B schedule. Rough draft and final submission dates are recorded on the SPHS IA Calendar.

	HL	**SL**
IA Topics/Proposals	Jan. 30th, 2021	Jan. 30th, 2021
IA Rough Draft	Mar. 6th, 2021	Mar. 6th, 2021
IA Final Draft	Mar. 31st, 2021	Mar. 31st, 2021

XIII. Sample exam questions

Paper 1	Define the term peripheral.	Answer: A piece of hardware / a hardware device that is externally connected or attached / remotely connected or attached to the computer system.

Paper 2	Construct code for the Genus object including a constructor, accessor methods and a toString() method. [3]
	
	Award [1 mark] for a constructor method requiring a single string as a parameter; Award [1 mark] for String getGenusName()and a set method for the genus name; Award [1 mark] for String toString()method that returns a valid string;
		Example:
		`public class Genus`
		`{`
		`private String genusName;`
		`public Genus(String g)`
		`{`
		`setGenusName(g);`
		`}`
		`public void setGenusName( String g )`
		`{ genusName = g; }`
		`public String getGenusName()`
		`{ return genusName; }`
		`public String toString()`
		`{`
		`return "Genus: " + genusName;`
		`}`
		`}`

Paper 3	Outline the meaning of the following terms: (a) threat landscape (b) whitelisting	(a) The threat landscape refers to the range of malware/dangers/threats or any singular danger; Award the second mark for a good expansion, for example: (Classified based on) the level of risk / the number of attacks / origin / attack vectors (or equivalent); That are (currently) putting IT systems/companies data/personal data/networks at risk; [2 marks] (b) Whitelisting refers to the production of a comprehensive set of websites/IP addresses/email addresses/MAC addresses/applications (Do not accept devices or users) Which are permitted to access the network/device / pass through the perimeter controls; [2 marks] Award [1 mark] only for "…fingerprint of acceptable applications" unless "fingerprint" is further explained. Award [1 mark] for "A list of trusted applications." without an expansion

XIV. Stony Point Academic Honesty Policy: All students are expected to abide by the SPHS Academic Honesty Policy. This policy is available on the SPHS IB website at www.stonypointib.com under Handbooks. The password is Tiger2021.

Here are some guidelines to help students define cheating and plagiarism. Students should report any suspected violations to these policies immediately.

Cheating

- Looking off another person's exam for answers
- Collaborating with others on work that is supposed to be completed independently
- Copying another student's homework, written assignments, examination answers, electronic media, or other data.
- Assisting or allowing someone else to cheat.
- Willfully copying or allowing class assignments to be copied and falsely presenting them as your own work and effort.
- Using unauthorized materials such as books, notes, or "cheat" sheets to answer examination questions
- Using or consulting electronic equipment including cell phones, PDA's, IPODS, etc. during a testing situation.
- Being informed or informing, verbally or otherwise, of test questions or answers either during or prior to the testing situation.

Plagiarism

- Representing the ideas, expressions, or materials of another without due credit.
- Paraphrasing or condensing ideas from another person's work without proper citation.
- Failing to document direct quotations and paraphrases with proper citation.
- Submitting a paper purchased from a research or term paper service, including the Internet.
- Undocumented Web source usage.

XV. Writing an Extended Essay in Computer Science: In extended essay (EE) in computer science provides students with an opportunity to investigate a particular aspect of computing and its implications for society and the world.

Within this context, students can research the latest developments and future possibilities in a rapidly changing subject that is continually breaking new barriers. There are many possible areas to be explored, each with a wealth of topics: advances in hardware and software development, comparison of the efficiency of algorithms designed to speed up data transmission or to encrypt data, network systems, computer control systems and so on.

Here are some examples and are intended for guidance only:

Topic	**Advances in machine learning: the effectiveness of reinforcement learning in turn-based strategy games**
Research question	How effective is reinforcement learning for improving performance in turn-based strategy games?
Approach	A practical investigation involving the comparison of the success of different algorithms in the playing of the Connect-4 game.

Topic	**The feasibility of wireless networking in a city-wide context**
Research question	To what extent is wireless networking a feasible alternative to cabled networking within a whole-city context?
Approach	A feasibility study of the hardware and communications needed to set up a city-wide network in wireless and cabled systems.

Topic	**Advances in computer processing**
Research question	How likely is it that fuzzy logic will replace binary logic in the next five years?
Approach	An investigation into the current state of implementation of multi-state logic and the differences between this and binary state logic.

XVI. Classroom Policy & Procedure:

Late Paper Policy: All work is due at the beginning of class. Late assignments will not be accepted after the 10th calendar day from when an assignment is due as specified in the gradebook. The maximum grade possible for late work is a 70.

Make Up Work Policy: Make up work will be accepted based upon student needs. All students can make up quizzes and tests by making corrections on each wrong question.

Classroom Expectations: All students will abide by the campus policies and procedures. Respect, integrity, and perseverance are expected within the classroom.

Equipment/Materials Policy:

Students are expected to properly use and take care of all equipment and materials in the classroom (virtual or in-person).

Classroom Procedures:

- **Student Handbook and Syllabus Policy:** Students must abide by the Student Handbook and class syllabus.
- **Start of Class:** When the class starts, students must be in the classroom (virtual or in-person), seated at their desk, and with all required supplies and ready to begin class. The teacher dismisses class.
- **Tardy:** Students that arrive tardy will be marked tardy as per school policy.
- **Bathroom:** Bathroom passes will not be allowed during the 15 minutes at beginning and end of class. With permission of the teacher, only one student at a time, with appropriate hall pass, may go to the nearest restroom.
- **Water:** Students are encouraged to bring water bottles to class as there is not time allotted during class to go to the water fountain. Water bottles will be placed away from equipment to avoid damage to any equipment.
- **Cell Phones:** Cell phones are to be kept in the students' backpacks and on silent mode or powered off.
- **Technology Use:** Students must use technology for teacher approved research/work only and follow school policy.
- **Schoology and HAC:** Grades are posted in a timely manner. Please review on a regular basis.
- **Submitting Assignments:** Please follow directions given by the teacher for each particular assignment.

Classroom Expectations:
While you are in my classroom, please:

- Be Prepared and On Time
- Be Engaged and Collaborative
- Be Respectful, Kind and Positive
- Practice Integrity
- Embrace a Growth Mindset
- Think Critically! Think Outside the Box! Ask Questions! Have Wonder and Amazement! Enjoy Learning! Have Fun!
- Adhere to the Student Code of Conduct