Brochure
How to prepare for the CST
BSc Computer Science & Engineering
2019-2020
How to prepare for part 2 the Cognitive Skills Tests (CST)

The Matching and Selection procedure for the BSc Computer Science and Engineering consists of three parts. The second part of the procedure is the selective part and will be proctored.

Part 2 the Cognitive Skills Tests (CST) consists of the following three parts:

- 2a. Mathematics
- 2b. Systematic Reasoning & Logical Thinking
- 2c. Algorithmic & Computational Thinking

2a. Mathematics
This element will test your mathematical skills. You can prepare for this by following the free online pre-university calculus course developed by the TU Delft. The syllabus will give you a better insight into what is expected from you in this test. The formula sheet will demonstrate the formulas that you do not need to know by heart and will always be available online during the test. The formula sheet is not exhaustive though, some of the formulas related to the material stated in the syllabus will be presumed. You need to know these by heart. You can find both documents in the appendix of this brochure.

2b. Systematic Reasoning & Logical Thinking
This test will relate to your systematic reasoning and logical thinking skills. You can prepare by studying chapter 2 (except 2.3) of the textbook Delftse Foundations of Computation. This book can be downloaded for free from the TU Delft Open Textbook repository.


2c. Algorithmic & Computational Thinking
This test will test your potential to solve puzzles, process-oriented thinking and your ability to come up with efficient solutions to real-world computational problems. You cannot prepare for Algorithmic & Computational Thinking as this is an aptitude test.

More information

- Website
- FAQ
- Timeline
- selection-bsc-cse@tudelft.nl

Disclaimer Please keep in mind that more information will be provided by e-mail for each step during the process.
Angle sum and difference identities

\[
\cos(\alpha - \beta) = \cos(\alpha)\cos(\beta) + \sin(\alpha)\sin(\beta)
\]  
(1)

\[
\cos(\alpha + \beta) = \cos(\alpha)\cos(\beta) - \sin(\alpha)\sin(\beta)
\]  
(2)

\[
\sin(\alpha - \beta) = \sin(\alpha)\cos(\beta) - \cos(\alpha)\sin(\beta)
\]  
(3)

\[
\sin(\alpha + \beta) = \sin(\alpha)\cos(\beta) + \cos(\alpha)\sin(\beta)
\]  
(4)

\[
\tan(\alpha - \beta) = \frac{\tan(\alpha) - \tan(\beta)}{1 + \tan(\alpha)\tan(\beta)}
\]  
(5)

\[
\tan(\alpha + \beta) = \frac{\tan(\alpha) + \tan(\beta)}{1 - \tan(\alpha)\tan(\beta)}
\]  
(6)

Double-angle formulae

\[
\cos(2x) = \cos^2(x) - \sin^2(x)
\]  
(7)

\[
= 2\cos^2(x) - 1
\]  
(8)

\[
= 1 - 2\sin^2(x)
\]  
(9)

\[
\sin(2x) = 2\sin(x)\cos(x)
\]  
(10)

\[
\tan(2x) = \frac{2\tan(x)}{1 - \tan^2(x)}
\]  
(11)
Syllabus 2a Mathematics Test

Below the minimum of expected knowledge for mathematics is presented. Note that the questions on the respective test might consist of a combination of multiple topics. The content in this syllabus is based on the material covered in Dutch VWO (i.e. pre-university education) schools.

Mathematics

The math problems can and have to be solved exact, i.e. without using approximation techniques or a graphic calculator. Moreover, unless stated otherwise, this also implies that you should not round your answers (e.g. 0.33 is not considered the same as 1/3).

1. Functions and Graphs
   i The candidate is able to recognize and construct compositions of standard functions. Standard functions include polynomial functions $x^n$, $n$-root functions ($\sqrt[n]{x}, x^{\frac{1}{n}}$), the power functions $a^x$, and its inverse the logarithm $\log_a(x)$, the exponential function $e^x$, and its inverse the natural logarithm $\ln(x)$, trigonometric functions $\sin(x)$, and $\cos(x)$.
   ii The candidate is able to analyze, draw and transform (compositions of) these standard functions, and to determine limits, domain, range, asymptotes and symmetry points or lines.
   iii The candidate understands the concept of inverse functions, and can find the inverse of (compositions of) standard functions.

2. Algebraic Solving
   i The candidate can rewrite expressions to isolate a variable and can substitute expressions into a given function.
   ii The candidate is able to rewrite expressions into simplified form and recognizes special products, and can use this knowledge to manipulate equations and inequalities composed of standard functions (see 1i) to find solutions of the form $y = f(x)$ or $y \leq f(x)$.
   iii The candidate is able to find roots of a function ($f(x) = 0$) using factorization techniques. The candidate is able to use the quadratic formula to find roots of quadratic equations ($ax^2 + bx + c = 0$).
   iv The candidate can solve systems of linear equations, \[
   \begin{align*}
   ax + by &= c \\
   dx + ey &= f
   \end{align*}
   \]
   with $a, b, c, d, e, f$ constants.
3. Differential Calculus

i The candidate knows the derivatives of standard functions, and is able to apply the product rule, quotient rule, and chain rule to determine derivatives of functions composed of standard functions.

ii The candidate is able to determine the first derivative \( (f'(x), \frac{dy}{dx}, \frac{d}{dx} f(x)) \) and second derivative \( (f''(x), \frac{d^2y}{dx^2}, \frac{d^2}{dx^2} f(x)) \) of functions and to use these to determine locally increasing and decreasing behavior, extreme values, locally concave and convex behavior, and inflection points.

iii The candidate is able to apply differentiation to determine the slope of a graph and the local tangent and normal lines to a function, to construct and solve an optimization problem, and to solve problems concerning distance, velocity and acceleration.

4. Integral Calculus

i The candidate understands the concept of integration and related terms (including limits of integration, definite/indefinite integrals and the constant of integration).

ii The candidate is able to determine the antiderivative or primitive of standard functions \( (F(x) = \int f(x)dx) \), and is able to use this to calculate definite and indefinite integrals of functions of the form \( cf(ax + b) + d \), with \( a, b, c, d \) constants.

iii The candidate is able to apply integration to determine the surface area, volume of a solid of revolution, arc length and the mean value of a function.

5. Trigonometry

i The candidate understands the trigonometric functions \( \sin(x), \cos(x) \) and \( \tan(x) \) and concept of the unit circle. The candidate understands the terms amplitude, phase, period, and frequency, and is able to convert degrees to radians and vice-versa.

ii The candidate knows the exact values of \( \sin(\theta), \cos(\theta) \) and \( \tan(\theta) \) for integer multiples of the following angles \( \theta \) in the first quadrant, \( \{0, \frac{\pi}{6}, \frac{\pi}{4}, \frac{\pi}{3}, \frac{\pi}{2}\} \), and to use periodicity and symmetry properties of \( \sin(\theta), \cos(\theta) \) and \( \tan(\theta) \).

iii The candidate is able to find all solutions of equations \( \sin(x) = c, \cos(x) = c \) and \( \tan(x) = c \), and of \( \sin(f(x)) = \sin(g(x)), \cos(f(x)) = \cos(g(x)) \) and \( \tan(f(x)) = \tan(g(x)) \), where \( c \) is a constant and \( f(x) \) and \( g(x) \) are linear functions of \( x \).

iv The candidate is able to apply the Pythagorean identity \( \sin^2(x) + \cos^2(x) = 1 \), sum and difference identities and double angle formulae.

6. Geometry

i The candidate is able to determine the surface and perimeter of two-dimensional shapes including triangles, rectangles, circles, etc. The candidate is able to determine the volume and surface area of three-dimensional figures including cubes, pyramids, cylinders, cones, etc.

ii The candidate can use properties of lines, triangles, circles, and quadrilaterals to determine lengths and angles. The candidate is familiar with the properties of a right-triangle, isosceles triangle, and equilateral triangle.

iii The candidate can use the Pythagorean theorem, sin-, cos-, tan-relations and the law of sines and the law of cosines to determine lengths and angles in triangles.

iv The candidate can formulate the equation for lines and circles, and knows the relations between the slopes of parallel and tangent lines.

v The candidate is able to find the intersections between lines and circles.
7. Vectors

i The candidate understands the concept of a vector, and can determine the length and direction of a vector.

ii The candidate can decompose vectors in components, can multiply a vector with a scalar, and can add and subtract vectors. The candidate can calculate the dot product of two vectors, and can use it for the calculation of angles and distances.

iii The candidate can calculate velocity and acceleration of a moving point whose path is described by a time-dependent vector representation.