Brochure

How to prepare for the CST
BSc Computer Science & Engineering
2020-2021
Brochure 3
How to prepare for the CST

In this brochure you will find all the information on how to prepare for the selective part of the Matching and Selection procedure: the Cognitive Skills Tests (CST).

For more information about the entire Matching and Selection procedure we would advise you to check the website and read brochure 2, which you can download from the bottom of that same page.

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Disclaimer Please keep in mind that more information will be provided by e-mail during the process.
How to prepare for the Cognitive Skills Tests (CST)

The Matching and Selection procedure consists of three parts. The second part of the procedure is the selective part (CST). Only candidates who have completed the first part of the procedure, the so-called NCSA, will be allowed to participate in the CST (art. 4.2.5).

The Cognitive Skills Tests (CST) contains the following three tests:
- 2A. Mathematics (40%)
- 2B. Systematic Reasoning & Logical Thinking (20%)
- 2C. Algorithmic & Computational Thinking (40%)

The percentages in between brackets indicates the relative weight used to calculate your final grade. For each test element you will have one hour. A counter showing the remaining time per element will be visible during the test. The complete CST will take a maximum of three hours in total. Once you start you have to complete the entire CST and once completed this part of the Matching and Selection procedure is finalized. You cannot re-sit or re-take the CST.

Practical matters during the CST

We recommend you to eat, drink and go to the bathroom prior to the CST. We encourage you to have some fruit and a bottle of water on your desk. Although snacks are allowed, try to ensure that opening them can be done without creating a lot of noise, as this may disturb others who are taking the tests. Make sure that your phone is completely switched off and out of sight.

2A Mathematics (40%)

This element will test your mathematical skills. You can prepare for this by following the free online pre-university calculus course (select the audit track) and by reading the syllabus and formula sheet, which can be found in the appendix of this brochure. The syllabus will give you a better insight into what is expected from you in this test. You should be able to apply techniques and formulas from memory, except for the formulas on the formula sheet, which will be available online during the test. Please remember that you will need to do all calculations by yourself as a calculator is not allowed (art. 4.1.8).

2B Systematic Reasoning & Logical Thinking (20%)

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 (art. 4.3.2). This book can be downloaded for free from the TU Delft Open Textbook repository. At TU Delft we train our students to become analytical engineers and curious problem-solvers. Although you will find exercises in the book, you will not find any official answers, nor do we provide these.

2C Algorithmic & Computational Thinking (40%)

In the final element of the CST we will test your potential to solve puzzles, process-oriented thinking skills and your ability to come up with efficient solutions to real-world computational problems (art. 4.3.3). You cannot prepare for the Algorithmic & Computational Thinking as this is an aptitude test.

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**Academic integrity**

The Cognitive Skills Tests (CST) is monitored by invigilators on campus or proctored if taken online, to ensure an honest procedure and to check whether all applicants comply with the academic integrity standards of the TU Delft. In accordance with article 4.1.6 of the regulation you will need to take the tests individually and without other sources of information.

**What you can have on your desk**
The following items are allowed on your desk while taking the tests (art. 4.1.7):

- Dictionary in book form (clear of any notes)
- Pencils/pens
- Bottle of water and some fruit and/or nuts
- Blank paper in single sheets (will be provided)
- Formula sheet mathematics (will be provided)

**What do you have to do**

- Bring your national identification card or passport
- Remember your login details
- Focus only on your tests
- Take the CST without other sources of information
- Follow instructions by invigilators
- Comply with academic integrity standards of the TU Delft
- Switch off your phone completely and keep it out of sight during the entire CST
- Report any issues encountered that might affect your score within 48 hours (art. 4.1.11)

**What is not allowed**

- A calculator is not allowed, nor one on another device (art. 4.1.8/4.1.9)
- Any (attempted) act or omission thereof that may result in making it more difficult or impossible to form an objective assessment constitutes fraud
- The Selection Committee can impose sanctions on fraud, like awarding zero points or excluding a candidate from the procedure (art.5.2/5.3)

**Set-up of the CST**
The questions will gradually become more difficult within all three test elements of the CST (art. 4.2.15). Your goal is to answer as many questions correctly as possible. Your score for each test is solely based on the number of correct answers. You will have one hour for each test, however the tests are designed such that the time available may not be sufficient to answer all questions. You can go forward and backward between questions within a test. Please note that once you have completed a test and have started with the next test, you cannot go back to the previous test, any time you had left for that particular test will be lost.

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Taking the CST on campus

We encourage all applicants to take the Cognitive Skills Tests (CST) on campus as this provides you with a unique opportunity to experience the campus and TU Delft first-hand and can help you in deciding what is the best study choice for you. From feedback from last year we learned that candidates would have preferred to take the CST on campus as this simplifies matters and was perceived to be less stressful.

TU Delft cannot guarantee that proctoring will work in all countries, as some countries have strict regulations and firewalls, which may mean that you require a VPN connection or that it is not possible to take the CST online. If you are in doubt about your internet connection or whether proctoring works in your country, we recommend you to take the CST at TU Delft.

We recommend you to eat, drink and go to the bathroom prior to the tests. If you really need to go, please remember that you are not allowed to communicate with anyone about the tests during that time.

How to get to the CST on campus location

- The exam hall is located in Building 35, Cornelis Drebbelweg 5, 2628 CM Delft
- The CST will take place in exam hall 1 (location 35-0-030)
- The nearest train station is Delft
- Make sure to check updated information on activities, roadblocks or public transport
- More information about food on campus
- The nearest airports to TU Delft are Rotterdam, The Hague, Schiphol (Amsterdam) or Eindhoven

We highly encourage you to explore the TU Delft campus, Delft and the surrounding area to get more acquainted and find out if this could be where you would like to study and possibly live. The quaint inner city of Delft is about a 10 minute bike ride from campus and within walking distance from the train station. The Hague, Rotterdam and Leiden are all within 10-20 minutes by train.

Self-Reflection Assessment (SRA)

After the CST all candidates need to complete the SRA online in your own time, before the deadline Tuesday 17th March 2020 at 13:59 CET in order to obtain a ranking number (art. 4.2.19).

Disclaimer Please keep in mind that more information will be provided by e-mail during the process.
Specific rules when taking the Cognitive Skills Tests (CST) online

We encourage all applicants to take the Cognitive Skills Tests (CST) on campus as this provides you with a unique opportunity to experience the campus and TU Delft first-hand and hereby help you in making the right study choice for you. From feedback from last year candidates indicated that they would have preferred to take the CST on campus as this simplifies matters and was perceived to be less stressful.

TU Delft cannot guarantee that proctoring will work in all countries, as some countries have strict regulations and firewalls, which may mean that you require a VPN connection or that it is not possible to take the CST online. If you are in doubt about your internet connection or whether proctoring works in your country, we recommend you to take the CST at TU Delft. Please note that only a limited number of online slots are available (art. 4.2.13).

For those who will take the (CST) online, please note that you will be remotely proctored. This means that you and your computer screen will be monitored during the CST to ensure that you comply with the academic integrity standards of the TU Delft. You are also responsible for assuring a well-functioning internet connection (art. 4.1.5) if you take the CST online. In addition to that you will need to take a test prior to the CST to ensure that you know how proctoring works, as well as read all the required information that will be provided online (art. 4.2.11).

We recommend you to eat, drink and go to the bathroom prior to the tests. If you really need to go, please remember that you are only allowed to go to the bathroom in between 2A and 2B or 2b and 2C. You are not allowed to go during a test if you are taking the CST online, as we cannot monitor what happens when you leave the room. Since what you do outside the view of the webcam can impact your test results it is important that you comply with this rule.

Proctoring requirements

When you take the CST online, make sure to check in advance whether your computer meets the requirements as set by our proctorer. Keep in mind that you need to have a stable internet connection. We recommend using a cable connection as opposed to WiFi.

Self-Reflection Assessment (SRA)

After the CST all candidates need to complete the SRA before the deadline Tuesday 17th March 2020 at 13:59 CET in order to obtain a ranking number (art. 4.2.19).

More information

- BSc CSE Matching & Selection
- FAQ
- selection-bsc-cse@tudelft.nl

Disclaimer Please keep in mind that more information will be provided by e-mail during the process.
Timeline
Application and Matching & Selection BSc CSE 2019/2020

1. Application
   A. Apply in Studielink
   B. Activate your TUD Net ID
   C. Continue in Osiris

   Apply from 1st Oct - 15th Jan 23:59 CET

2. Register for CST
   After completion of application you will receive an invite to sign up for the CST

   Sign up for CST 23rd Jan 13.59-23.59 CET

3. Take NCSA
   Non-Cognitive Skills Assessment online

   NCSA 31st Jan - 14th Feb 13:59 CET

4. Confirmation slot CST
   After completion of NCSA you will receive an unconditional confirmation of CST slot

   Receive CST/SRA invite before 28th Feb

5. Take CST & SRA
   A. Cognitive Skills Tests (CST) at TU Delft*
   B. Self-Reflection Assessment online

   CST & SRA 28th Feb - 17th Mar 13:59 CET

   Receive ranking# starting 15th April

6. Ranking
   Studielink informs student of rank#

7. Accept & Finalize
   A. Accept your spot within 2 weeks
   B. Finalize registration in Studielink

   Accept spot within 2 weeks

Start in time, all deadlines are fixed!

* You can take the CST at TU Delft on different dates, only 175 spots are available online
Angle sum and difference identities

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

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

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

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

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

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

Double-angle formulae

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

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

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

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

\[
\tan(2x) = \frac{2 \tan(x)}{1 - \tan^2(x)} \quad (11)
\]
Syllabus 2a Mathematics Test v2020.1

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.

The standard mathematical terms are written in **boldface**. Note that these terms might be very different in your native language. It is advised to check those terms carefully, look up the terms that you do not recognize and make a list of translations to your native language.

**Mathematics**

The math problems can and have to be solved exactly, 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** \( \sin(x), \cos(x) \) and \( \tan(x) \), and the **absolute value function** \( |x| \).
   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 and solve **equations** and **inequalities** of the form \( f(x) = g(x) \), \( f(x) \leq g(x) \), \( f(x) < g(x) \), \( f(x) > g(x) \) and \( f(x) \geq g(x) \), where \( f \) and \( g \) are (compositions of) standard functions (see 1i)
   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**, \( \begin{cases} ax + by = c \\ dx + ey = f \end{cases} \), 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 \( f'(x) \), \( \frac{dy}{dx} \), \( \frac{d^2y}{dx^2} \), \( f''(x) \) of functions and to use these to determine locally increasing and locally decreasing behavior, extreme values, and inflection points.

iii The candidate is able to apply differentiation to determine the slope of a graph and the local tangent lines 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 integration constant).

ii The candidate is able to determine antiderivatives (also called primitive functions) of standard functions, 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 and \( f \) a standard function.

iii The candidate is able to apply integration to determine the surface area, volume of a solid of revolution 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 can relate those to the parameters in a sinusoidal function such as \( f(t) = d + a\sin(b(t - c)) \). The candidate 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 the following angles \( \theta \in \{0, \frac{\pi}{4}, \frac{\pi}{3}, \frac{\pi}{2}, \frac{3\pi}{4}, \frac{2\pi}{3}, \frac{5\pi}{6}, \pi \} \), as well as integer multiples of these angles.

iii The candidate is able to use periodicity and symmetry properties of \( \sin(\theta) \), \( \cos(\theta) \) and \( \tan(\theta) \).

iv 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 \( x \).

v 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 \( x \).

vi The candidate is able to solve inequalities \( \sin(f(x)) \leq c \), \( \cos(f(x)) \leq c \) and \( \tan(f(x)) \leq c \), where \( c \) is a constant and \( f(x) \) and \( g(x) \) are linear functions of \( x \). The same for \( \leq \) replaced with \( <, > \) or \( \geq \).

vii 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 objects 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 equations for lines and circles, and knows the relations between the slopes of normal 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 norm (i.e. 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 and to detect orthogonality.

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

Remark:
Vectors will be denoted boldface or with an arrow: \( \mathbf{v} \) or \( \vec{v} \). When expressed in components, a vector will denoted using round brackets, e.g. \( \left( \begin{array}{c} 3 \\ -5 \end{array} \right) \). The norm (= length) of a vector \( \mathbf{v} \) will be denoted as \( \| \mathbf{v} \| \).