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# Brochure

How to prepare for the CST

BSc Computer Science & Engineering

2021-2022



## 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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## 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 between brackets indicate the relative weight used to calculate your final grade. Mathematics and Algorithmic & Computational Thinking each take one hour to complete and Systematic Reasoning & Logical Thinking takes 45 minutes. A counter showing the remaining time per element will be visible during the test. The complete CST will take a maximum of two hours and 45 minutes in total. Once you start you have to complete the entire CST in one session. Once the CST is 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. Make sure that your phone is completely switched off and out of sight. Let the people around you know that you are taking the CST so they do not disturb you (which could be seen as fraud) or make a lot of noise which could distract you during the test. Make sure you have a good environment to take the CST with well functioning equipment and internet connection. Note that this is the responsibility of the candidate (art. 4.1.5).

### 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.



S. Hugtenburg & N. Yorke-Smith (2018) *Delftse Foundations of Computation*.  
Retrieved from <https://textbooks.open.tudelft.nl/index.php/textbooks/>

### 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.

## Academic integrity

The Cognitive Skills Tests (CST) is proctored if taken online or monitored by invigilators if taken on campus, 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 (not a pencil case)
- Bottle of [water](#) and some fruit and/or nuts
- Blank paper in single sheets
- Formula sheet mathematics (will also be provided digitally in the CST environment)

### What do you have to do

- Have your national identification card or passport present
- Remember your login details
- Take the CST without other sources of information
- Make sure no one will disturb you and focus only on your tests
- 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)

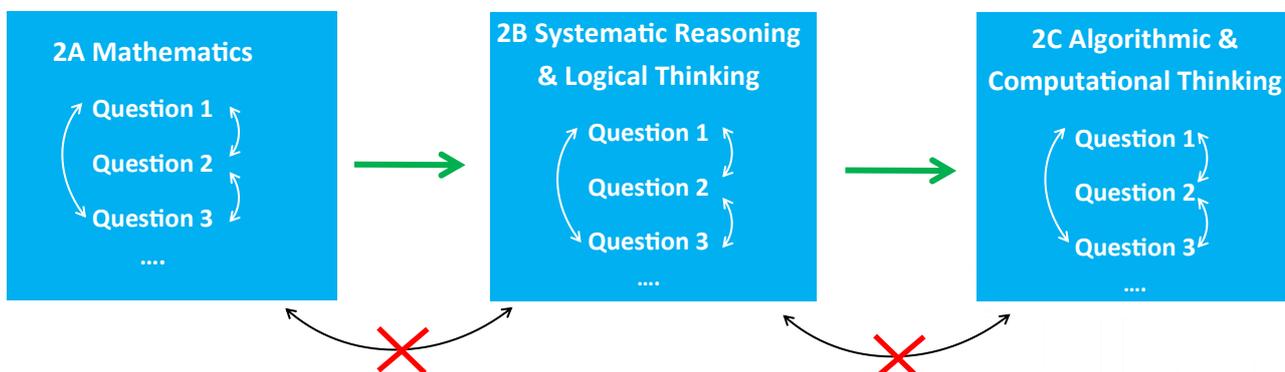
### What is **not** allowed

- A calculator is not allowed, nor is a calculator on an other device (art. 4.1.8)
- Headphones or earplugs are not allowed
- 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. 4.2.17). Your goal is to answer as many questions correctly as possible. Your score for each test element is solely based on the number of correct answers. You will have a set time frame for each test element. 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.



## Taking the Cognitive Skills Tests (CST)

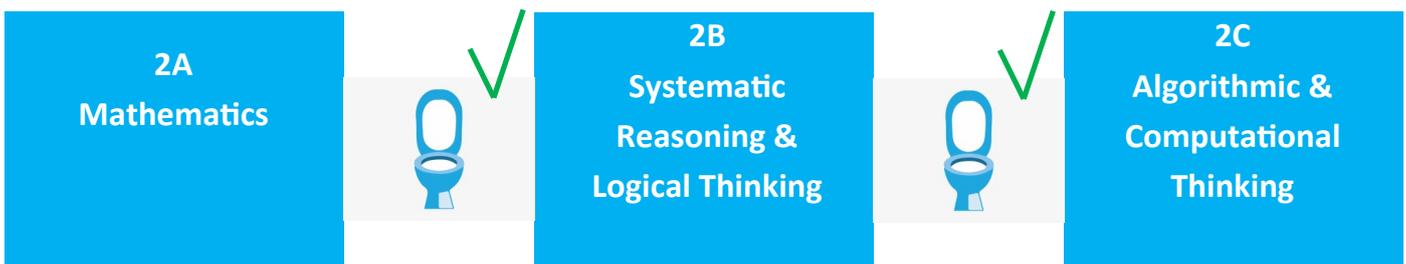
### Taking the CST online

Due to the Covid-19 pandemic all candidates will be able to take the CST online this year. To ensure an honest selection procedure all candidates who take the CST online will be remotely [proctored](#), which means that candidates are “followed” online to check whether the test is completed under the correct conditions (art. 4.2.12). Your and your computer screen will be monitored during the CST to ensure that you comply with the academic integrity standards of the TU Delft.

### Candidate responsibilities

You are responsible for assuring good working equipment and a well-functioning internet connection if you take the CST online (art. 4.1.5). 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. 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. You are responsible yourself to ensure you are able to take the CST online.

We recommend you to eat, drink and go to the bathroom prior to the tests. If you really need to go to the bathroom during the CST, please remember that you are only allowed to quickly go to the bathroom in between test 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. Please also make sure that nobody enters your room when you are taking the CST, as this could be seen as fraud by the selection committee.



### 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. These requirements will be available at the beginning of the Matching and Selection procedure. Make sure your computer has a working webcam and microphone (headsets or ear pods are not allowed). 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)

In order to obtain a ranking number all candidates need to complete the SRA online after taking the CST (art. 4.2.21). The SRA can be completed in your own time, before the deadline on **Monday 15 March 2021 at 09:59 CET**. You cannot prepare for the SRA. The SRA is intended to let you reflect on your study choice and the matching and selection procedure.

## Prepare for studying at the TU Delft

We would like to stress that you orientate on what you can expect from studying at the TU Delft. We recommend applicants to follow at least one of the (online) [information activities the TU Delft offers](#), so that you can find out if Computer Science & Engineering at TU Delft is the best education for you. More information on choosing the right study can be found in brochure 1, which can be found in the relevant documents list on our website. For international students we want to emphasize that it is important that you orientate on what you can expect from living and studying in the Netherlands.



Two subjects we would like to highlight, as this could have a big impact on your study progress, are the Binding Study Advice (BSA) and study duration.

### Binding Study Advice (BSA)

Admission to the programme means that you have fulfilled the entry requirements. The Matching and Selection procedure attempts to make a good match between your capabilities and the requirements of the programme, however starting the programme is no guarantee for success. All Dutch universities are required by Dutch law to issue a [binding recommendation on the continuation of studies \(BSA\)](#). This BSA determines whether you may continue with your programme based on the amount of EC you obtained during your first year. By passing a course you will obtain 5 EC. At TU Delft you will have to obtain at least 45 of the 60 EC in your first year. Students who obtain fewer than 45 EC will receive a negative BSA. This means that your registration will be terminated and you will *not* be allowed to register for the same programme for the upcoming four years. On average the number of students per year who receive a positive BSA at the end of their first year and are allowed to continue with the BSc CSE programme is 57%.

### Study duration

It is also important that you are aware of the consequences of *not* achieving all your courses: 60 EC in your first year. Although achieving 45 EC allows you to continue your studies, it will most likely also result in a study delay. Most students who receive less than 60 EC in the first year usually take at least one extra year to obtain their bachelor degree, which will certainly add to the total costs of your study. Only 34% of the Computer Science & Engineering students at the TU Delft complete the programme within 4 years.

## More information

- [BSc CSE Matching & Selection](#)
- [FAQ](#)
- [selection-bsc-cse@tudelft.nl](mailto:selection-bsc-cse@tudelft.nl)

# Timeline

Application and Matching & Selection BSc CSE 2020/2021

## 1. Application

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



**Apply 1<sup>st</sup> Oct - 15<sup>th</sup> Jan 23:59 CET**

## 2. Complete NCSA

Non-Cognitive Skills Assessment online



**NCSA 29<sup>th</sup> Jan - 12<sup>th</sup> Feb 13:59 CET**

## 3. Register for CST

Seat registration for the CST



**CST sign up 8<sup>th</sup> Feb - 12<sup>th</sup> Feb 13:59 CET**

## 4. Confirmation slot CST

After completion of the NCSA you will receive the confirmation of your CST slot



**Receive CST invite before 1<sup>st</sup> Mar**

## 5. Take CST

Cognitive Skills Tests online



**CST 2<sup>nd</sup> Mar - 12<sup>th</sup> Mar 12:59 CET**

## 6. Complete the SRA

Self-Reflection Assessment online



**SRA 2<sup>nd</sup> Mar - 15<sup>th</sup> Mar 09:59 CET**

## 7. Ranking

Studielink informs student of rank#



**Receive ranking# starting 15<sup>th</sup> April**

## 8. 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!**

# Formula sheet: Mathematics - v2020.1

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 ( $f'(x)$ ,  $\frac{dy}{dx}$ ,  $\frac{d}{dx}f(x)$ ) 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 **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  $\theta, \{0, \frac{1}{6}\pi, \frac{1}{4}\pi, \frac{1}{3}\pi, \frac{1}{2}\pi\}$ , 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 be denoted using round brackets, e.g.  $\begin{pmatrix} 3 \\ -5 \end{pmatrix}$ . The norm (= length) of a vector  $\mathbf{v}$  will be denoted as  $\|\mathbf{v}\|$ .