CST™- Coding Simulation Test

Engine 2.0

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CST™: Coding Simulation Test

The coding engine assesses codes for correctness as well as efficiency. It evaluates a candidate's code based on pre-defined test cases by comparing the output computed by candidate's code with the desired output guideline as outlined in the problem statement along with checking for boundary (extreme or special) conditions and performance cases.

Parameters Assessed

- **Code Correctness:**
  - Application of key coding concepts
  - Logical **problem-solving** ability
  - **Completeness** of coding solution, case coverage
- **Code Quality**
  - **Complexity – Efficiency** of algorithm
  - **Warnings** – Ability to write clean code

Relevant Job Roles

IT Product

- Software Developer
- Application Developer
- Full Stack Developer
- Data Scientist

IT Services

- Software Engineer
- Application Maintenance Engineer
- Software Test Engineer
- IT Analyst
- Business Analyst

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Comprehensive and robust code evaluation logic

Features of a good code

- Logically correct and complete
- Algorithmically efficient (consumes less memory and time)

Quality Element	Evaluation Parameter	Check Description
Code Correctness*	Completeness	▪ Desired output must be generated by the code ▪ Detection of Hard coding
	Boundary Conditions	▪ Code must work for all inputs, including special and extreme cases
	Performance	▪ Code must be optimized for long and complex calculations
Code Efficiency	Cyclomatic Complexity	▪ Check to ensure that minimum number of branches and independent paths are used ▪ Code complexity compared with seed value
	Warnings	▪ Code to be penalized for relevant warnings

**The coding engine consists of multiple test cases across levels which helps in better segregation of candidates*

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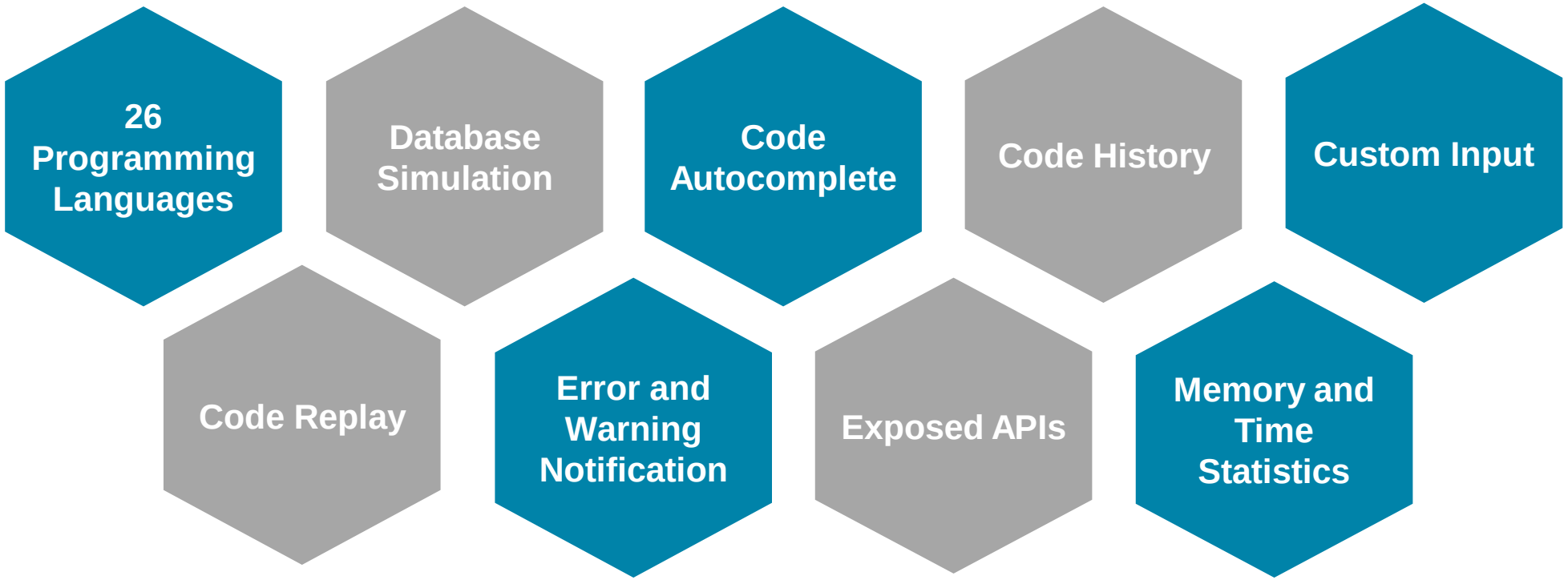
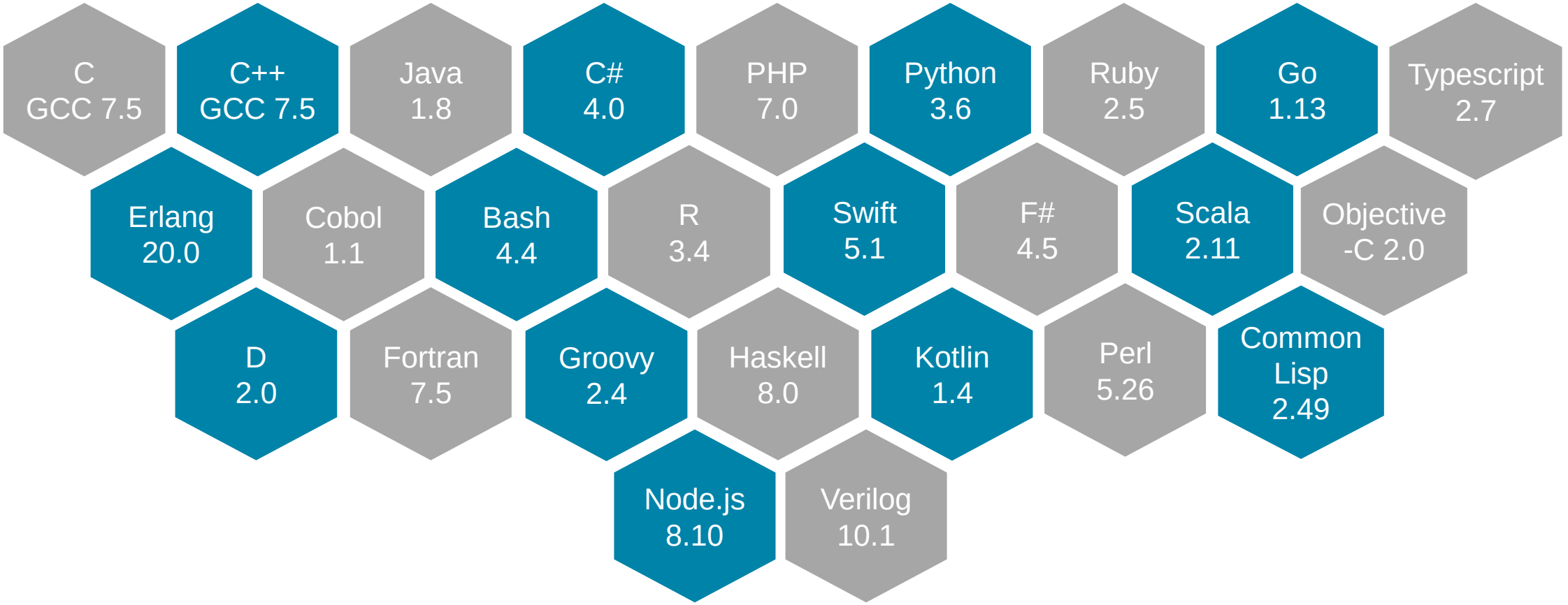
Platform Features



Programming Languages



Coding Assessment Lifecycle

The coding assessment lifecycle is broadly categorised into following 3 phases. The platform features are applicable at various stages of the lifecycle.

Assessment Development and Deployment

Assessment Attempt

Shortlisting and Interview

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Assessment Development and Deployment

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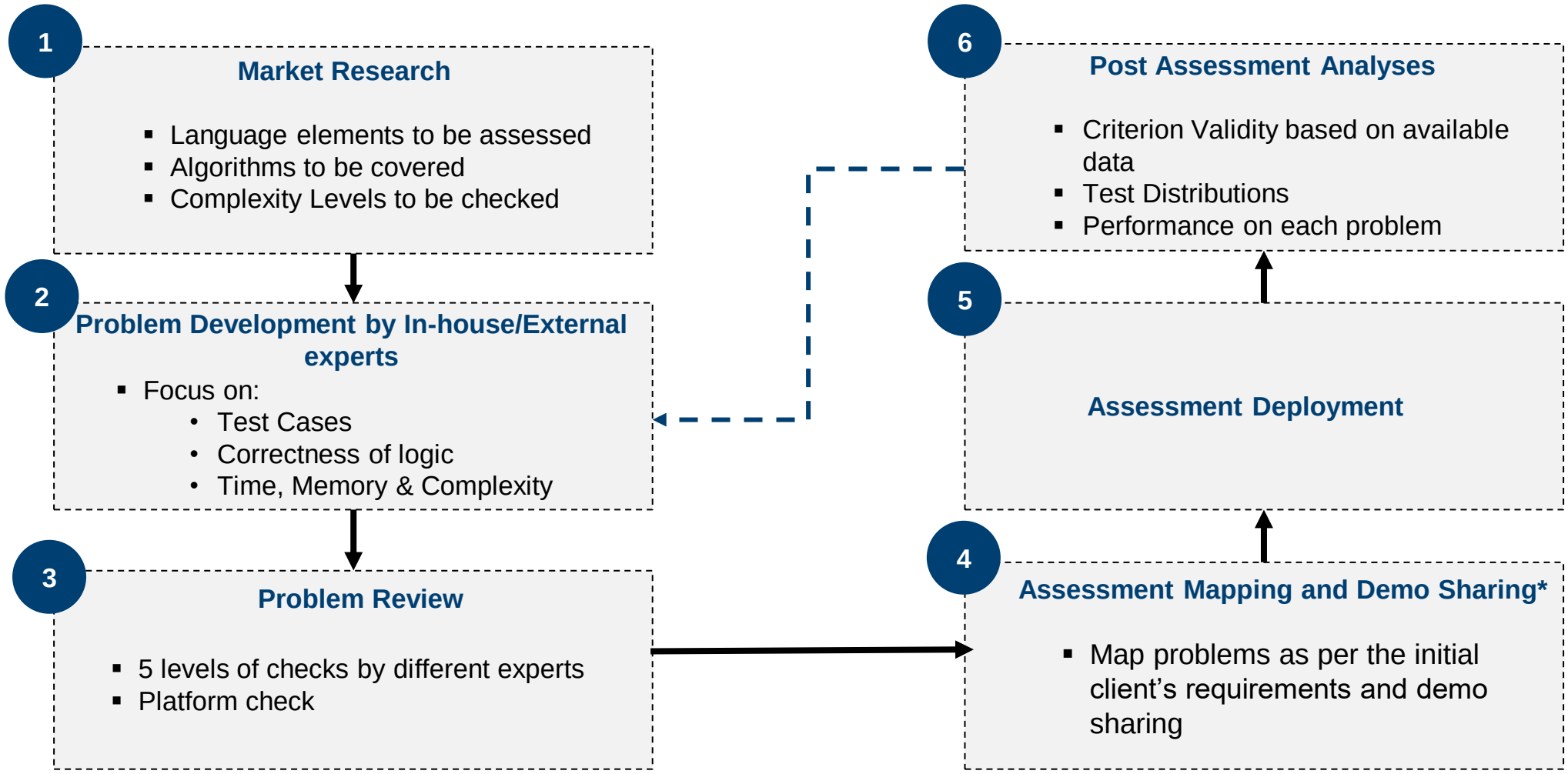
Assessment Development Methodology



*Scope of customization – topics, problem count, difficulty level, weightage of the test cases, and languages.

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Algorithm Based Items across the entire skill spectrum

Level – 1	Level – 2	Level – 3	Level – 4
Time to code: 10 -15 mins Scoring: Uni-Level	Time to code: 15 - 20 mins Scoring: Bi-level	Time to code: 25 - 30 minutes Scoring: Multi-level	Time to code: 30 - 40 minutes Scoring: Multi-level

Concepts covered

• Basic concepts such as if, if-else, switch • Arithmetic and conditional operators • Single-loop • Basic function related concepts	▪ Concepts covered in “Level - 1” ▪ Operator ▪ Looping concepts ▪ Arrays and Strings	▪ Concepts covered in “Level 1 and 2” ▪ Pointers ▪ Dynamic Memory ▪ In-place operations ▪ Simple Recursion	▪ Concepts covered in “Level 1, 2 and 3” ▪ Advanced data structures ▪ Dynamic programming concepts ▪ Advanced Recursion

Example Problems

Find whether a given year is a leap year	Find the second largest element in an array	Merge two sorted linked lists in-place	Multiplication of two polynomials represented as linked lists

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Database Based Items across the entire skill spectrum

Level – 1	Level – 2	Level – 3	Level – 4
Time to code: 10 -15 mins Scoring: Uni-Level	Time to code: 15 - 20 mins Scoring: Bi-level	Time to code: 25 - 30 minutes Scoring: Bi-level	Time to code: 35 - 40 minutes Scoring: Bi-level

Concepts covered

▪ SQL Functions such as Aggregate functions, Server functions, etc. ▪ SQL Operators ▪ Basic Select	▪ Concepts covered in “Level - 1” ▪ DDL, DML Commands ▪ Combination of operations like Functions and Clauses ▪ Advanced Select	▪ Concepts covered in “Level 1 and 2” ▪ SQL Joins ▪ SQL Normalization ▪ SQL Trigger	▪ Concepts covered in “Level 1, 2 and 3” ▪ SQL Functions ▪ SQL Stored Procedure ▪ Creation of whole database

Example Problems

Print the roll number of the students sorted by their names in alphabetical order.	Print the data of all the students whose name starts with a vowel.	Create a view to find the count of distinct students who attempted the exam.	Use Stored Procedure to update the salary of employees.

Data Science Based Items across the entire skill spectrum

Level – 1	Level – 2	Level – 3	Level – 4
Time to code: 10 -15 mins Scoring: Uni-Level	Time to code: 15 - 20 mins Scoring: Bi-level	Time to code: 25 - 30 minutes Scoring: Bi-level	Time to code: 35 - 40 minutes Scoring: Bi-level

Concepts covered

▪ Basic functions of Pandas, NumPy libraries	▪ Concepts covered in “Level - 1” ▪ Multiple functions and operations of Pandas, NumPy, SciPy and other libraries of Data Science. ▪ Data Manipulation ▪ Data Processing	▪ Concepts covered in “Level 1 and 2” ▪ Data Transformation ▪ Hypothesis Testing ▪ Statistical Data Analysis	▪ Concepts covered in “Level 1, 2 and 3” ▪ Regressions ▪ Predictive Models ▪ Data Validation ▪ Clustering

Example Problems

Print the data of students having Grades greater than 2 for a given Subject name.	Perform Hypothesis testing and t-test using stats.ttest_ind and find p-value for given list.	Find out the maximum correlation of each column against other columns.	Statistically analyze the birth rate in the country and find the trimmed mean, weighted mean, median..

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Scoring Logic

The programming scores are evaluated based on three types of test cases:

- **Basic Cases:** The basic test cases evaluate the correctness and completeness of the code. It checks if the written code is error-free.
- **Edge Cases:** These edge cases are special cases designed for the problem statement that evaluate the code for a particular situation that occurs only at a specific condition.
- **Performance Cases:** The performance cases evaluate the code's efficiency and scalability.

Scoring Type	Cases Evaluated	Weightage
Uni-Level Scoring	Basic Cases	100%
Bi-Level Scoring	Basic Cases + Edge Cases	(60-80)% + (20-40)%
Multi – Level Scoring	Basic Cases + Edge Cases + Performance Cases	(40-60)% + (20-30)% + (20-30)%

* For each basic case that a code passes, the score assigned to the basic case will be added to the overall score of the candidate.
** For Bi-level and Multi-Level Scoring, Edge/Performance cases will be evaluated once all the basic test cases are cleared, else candidates will be awarded a score based on the number of correct basic cases.

Assessment Deployment

Aon's Coding Assessment Engine will help HR teams to deploy fair and wide-ranging assessments in an independent manner with the help of the following features.

Self Serve Platform

Allows HR teams to rapidly create and deploy tests, customize test setting and pick items which needs to be deployed.

26 Programming Languages

Wide coverage of programming languages will allow to assess candidates across the organization's entire skill spectrum

Verilog Assessments

Platform supports deployment of Hardware Description Language (HDL) that simulates signals to hardware modules on which the code is tested

Database Assessments

Platform supports deployment of database language assessments for MS SQL, MySQL and Postgre SQL.

Leaked Question Detection

Platform provides the ability to identify problems that have been leaked on the Internet and remove them from the deployment pool

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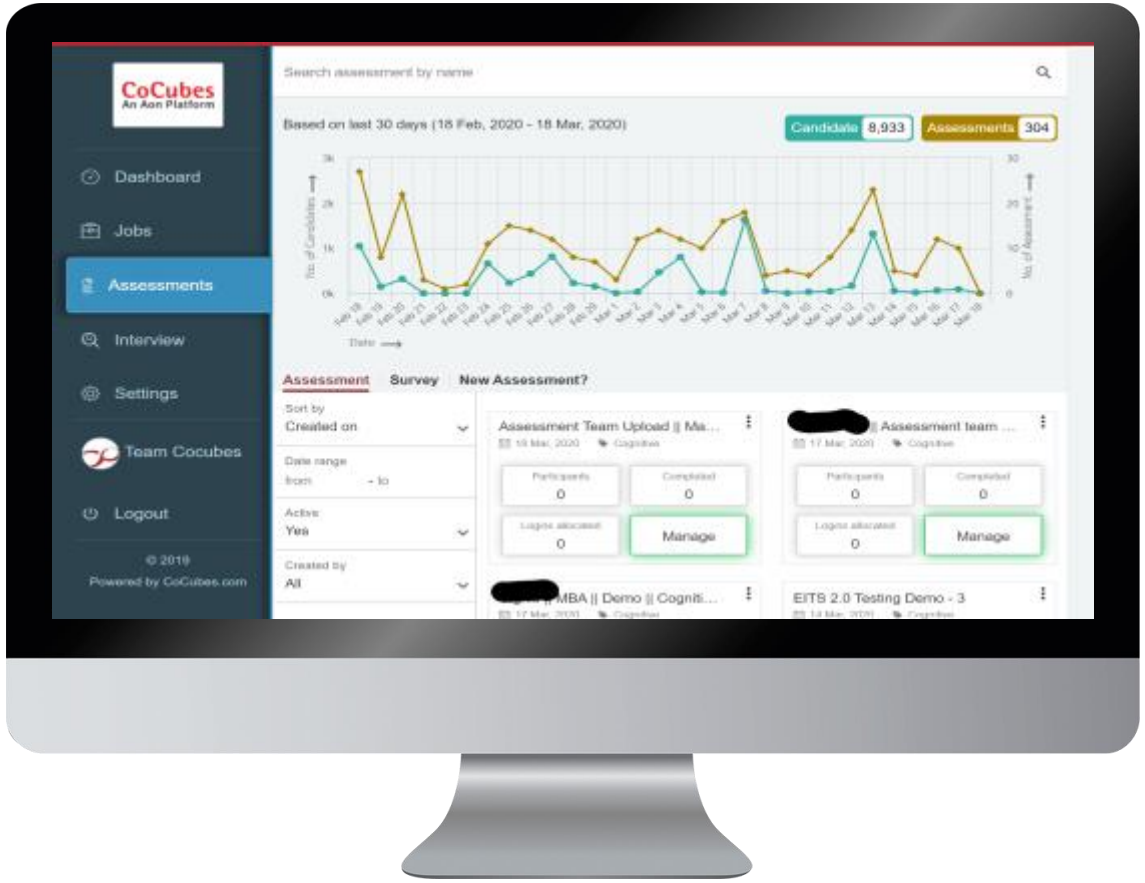
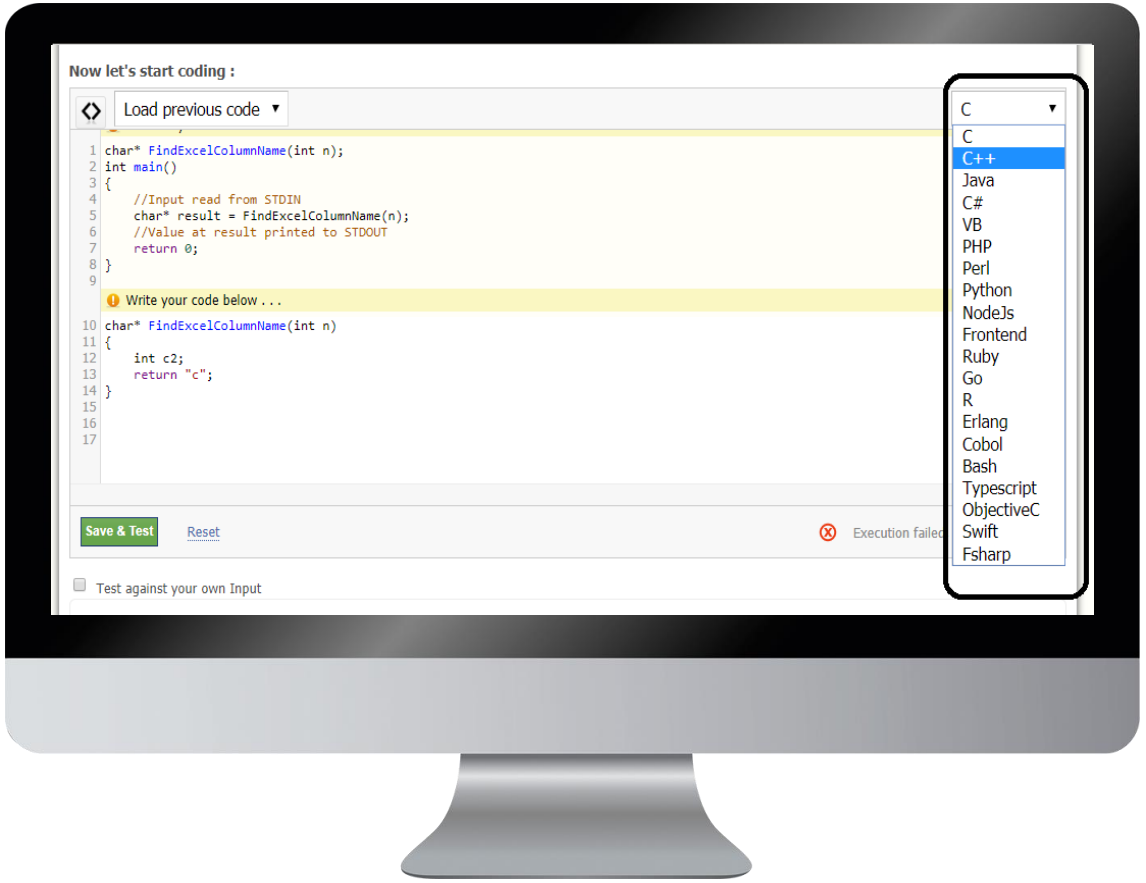
Sample Screenshots

Self Serve Platform



30 Programming Languages



Supported Languages: C, CPP, Java, C#, Verilog, PHP, Perl, Python, NodeJS, Ruby, Go, R, Erlang, Cobol, Bash, TypeScript, ObjectiveC, Swift, F#, Scala, Common Lisp, D, Fortran, Groovy, Kotlin and Haskell

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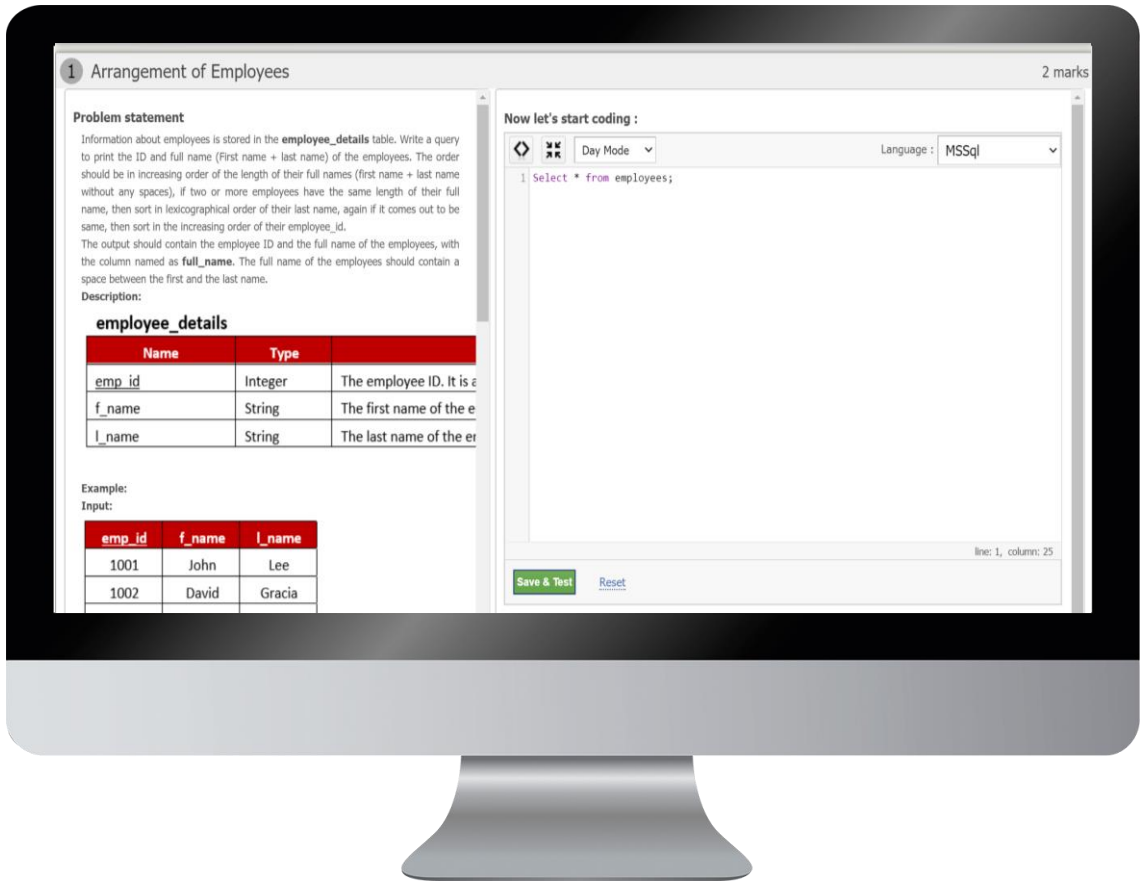
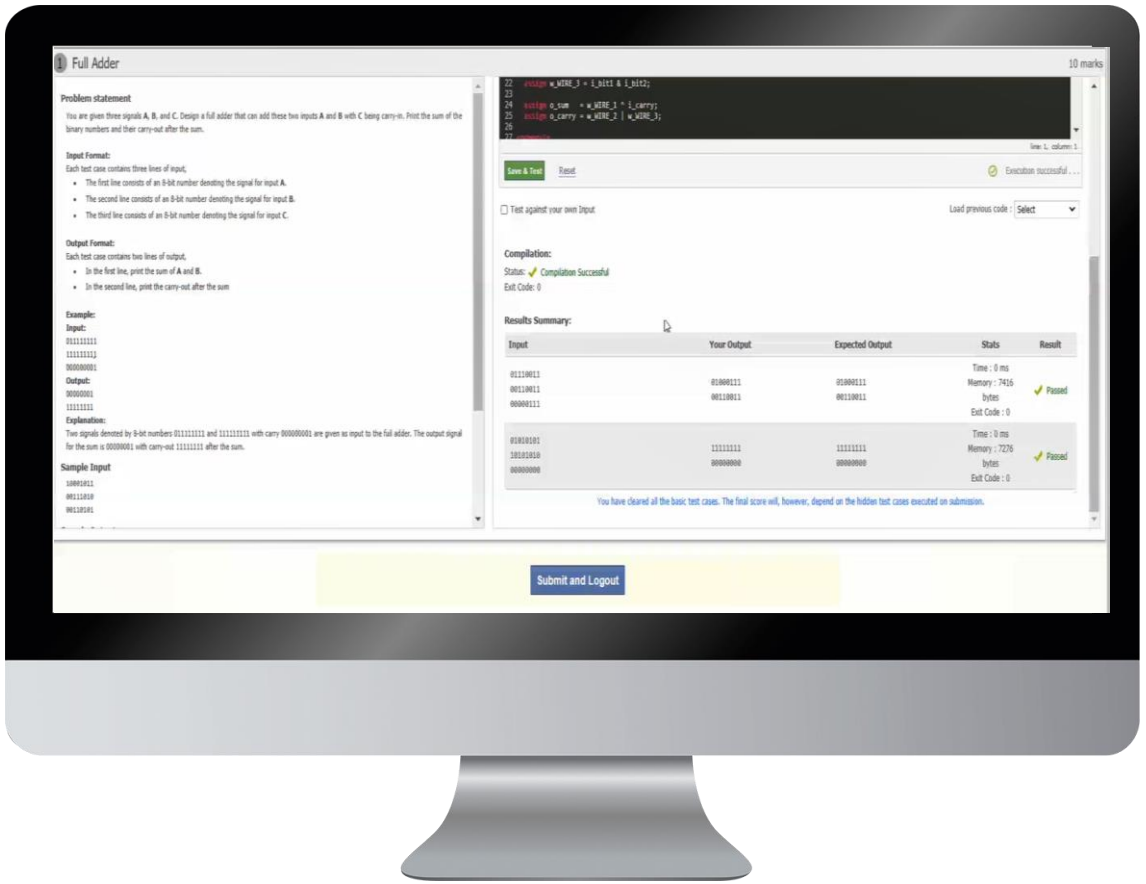
Sample Screenshots

Database Assessments



Verilog Assessments



Supported Languages: MS SQL, MySQL, PostgreSQL.

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Assessment Attempt

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Assessment Attempt

Aon's Coding Assessment Engine provides a pleasant/satisfactory candidate experience and allow them to code efficiently with the help of following features.

Code Autocomplete

Allows candidates to auto-populate language specific keywords and declared variables to improve their coding efficiency

Custom Input

Provide candidates an option to test their code submission w.r.t custom inputs

Code History

Past successful code compilations can be loaded quickly during an assessment session to return to any previous state

Error and Warning Notification

UI for error and warning notification window allows candidates to quickly focus on critical errors

Memory and Time Statistics

The statistics are displayed per test case result that helps developers write better code

Night Mode

Provides ease of use to candidates appearing from dark take-from-home environments

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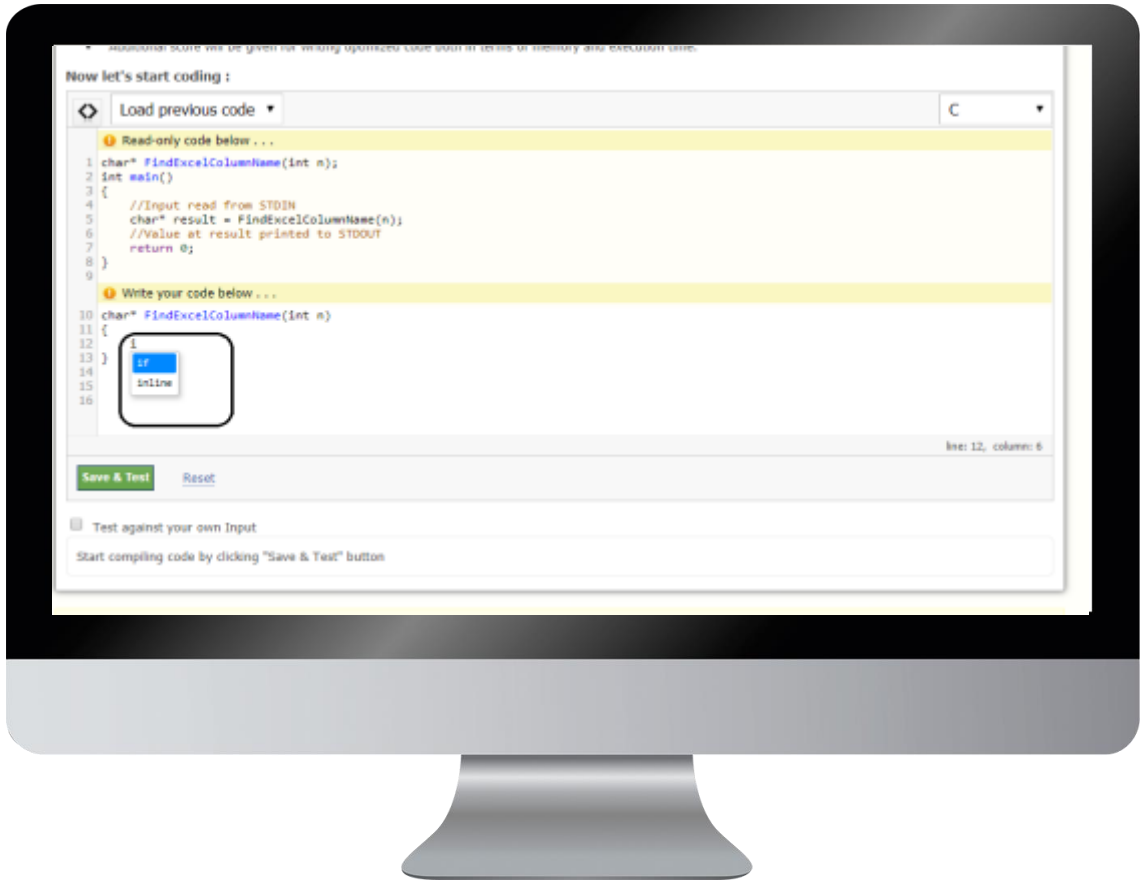
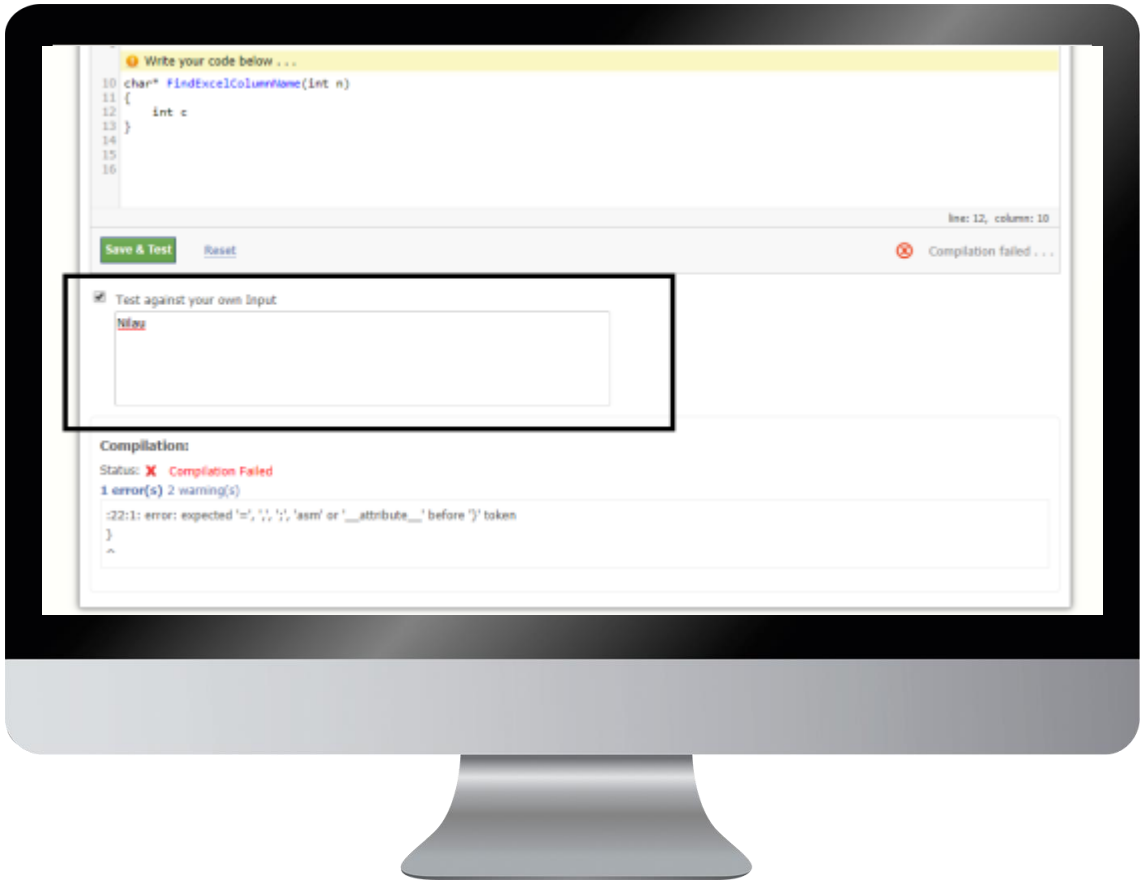
Sample Screenshots

Code Autocomplete



Custom Input



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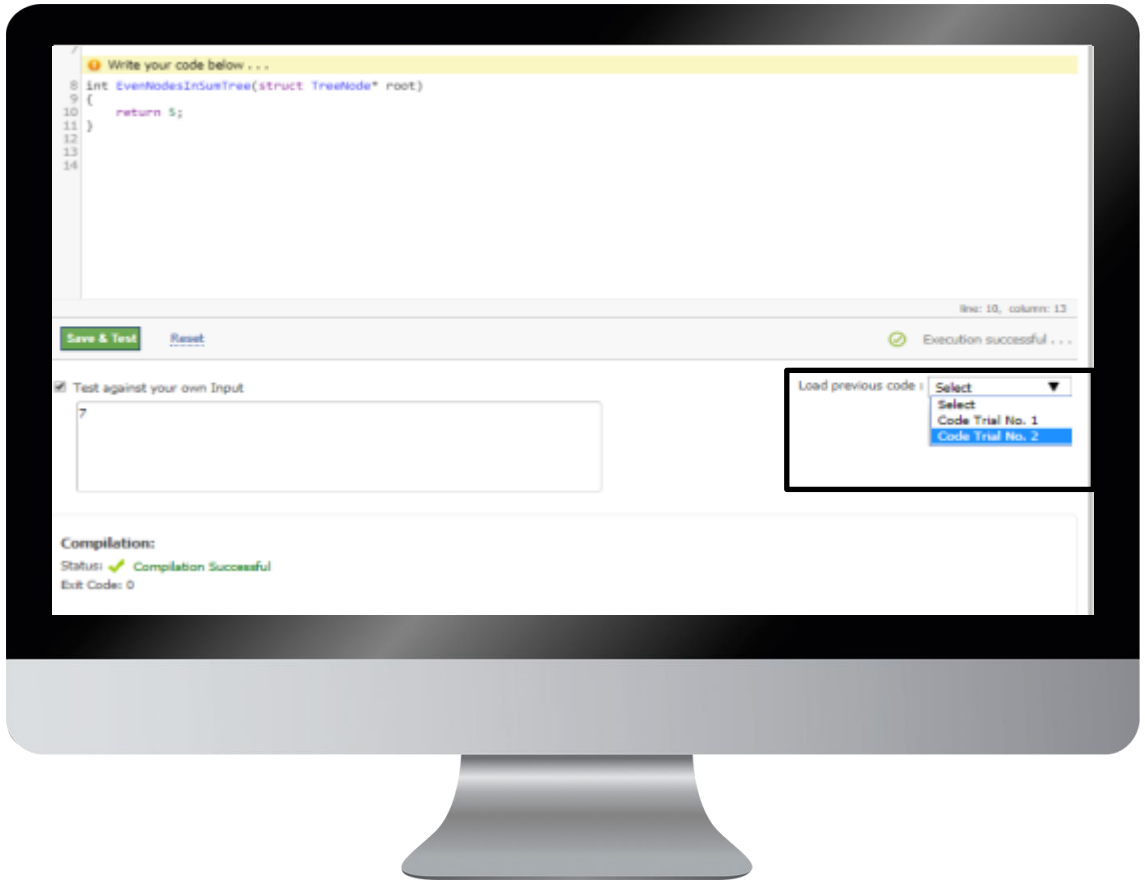
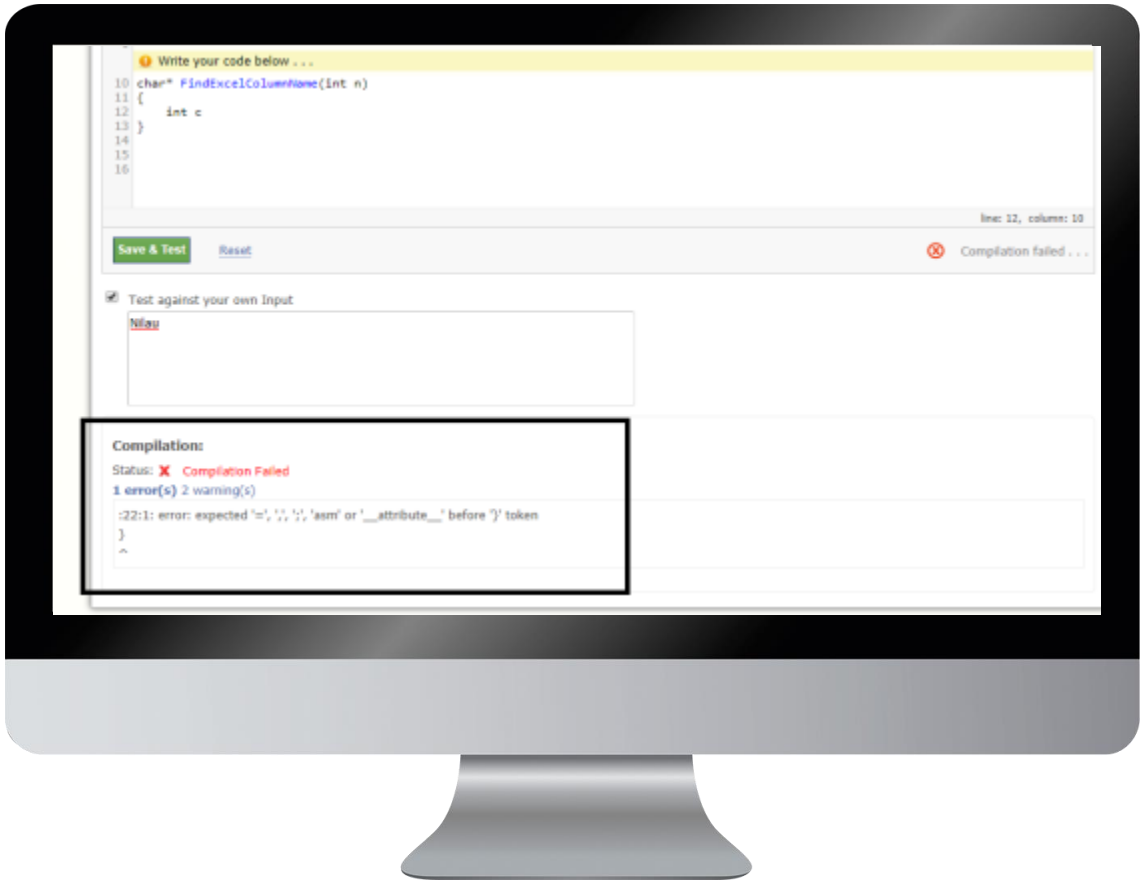
Sample Screenshots

Code History



Error and Warning Notification



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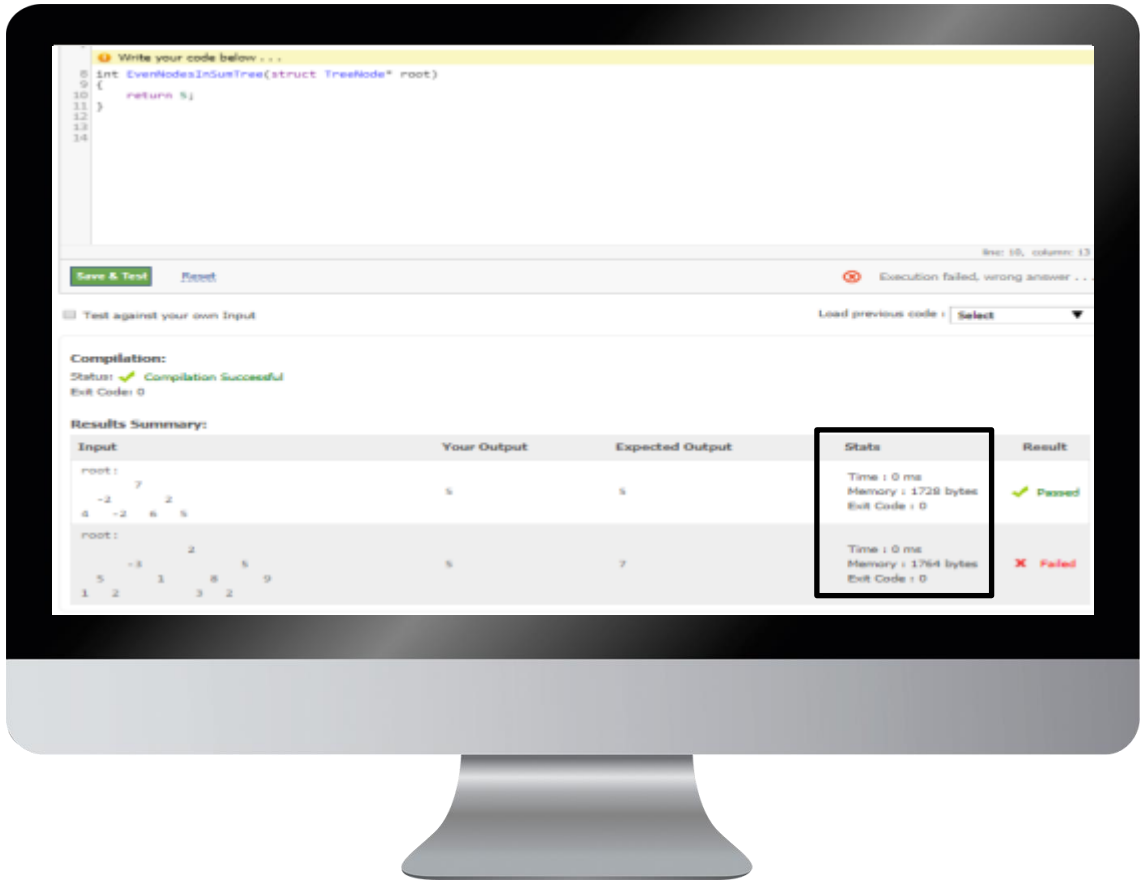
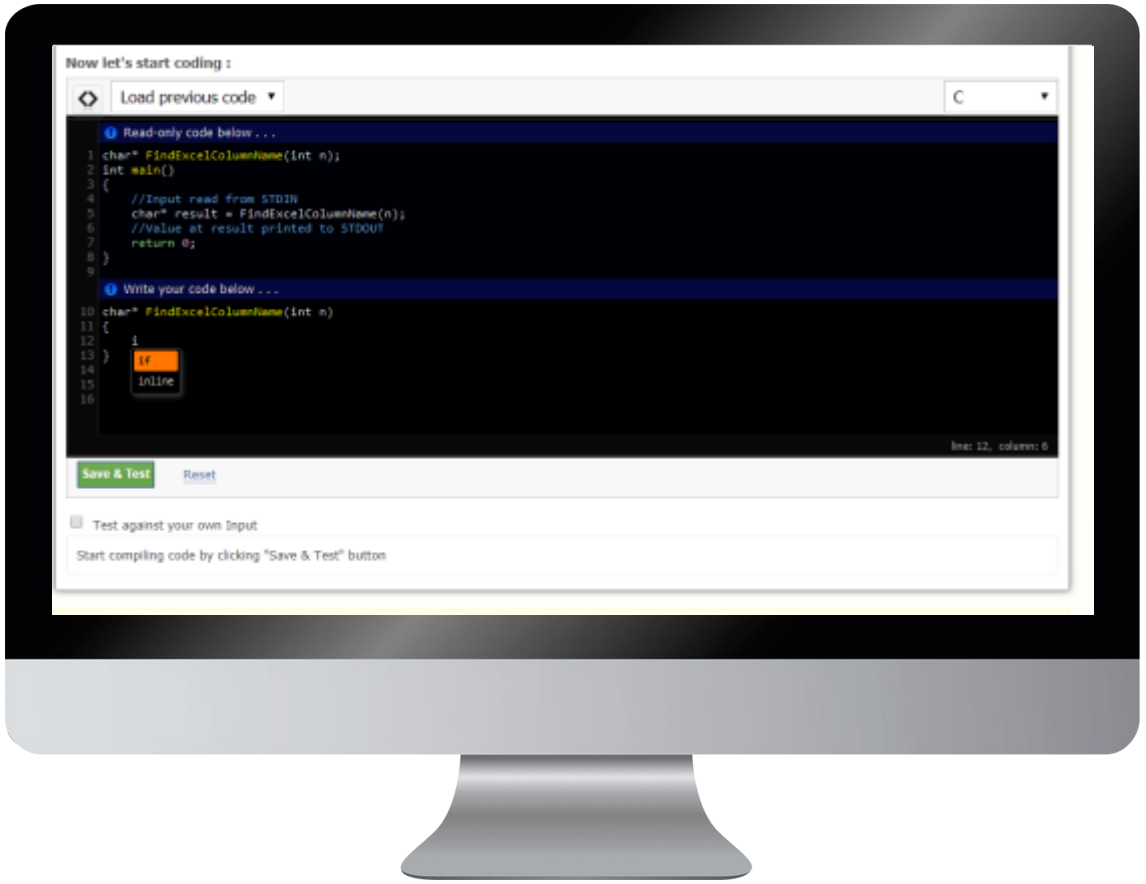
Sample Screenshots

Memory and Time Statistics



Night Mode



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Shortlisting and Interview

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Shortlisting and Interview

Aon's Coding Assessment Engine can shorten the time taken for shortlisting candidates and provides the ability to conduct remote interviews when combined with Aon Live (Video Interview Product).

Group and Individual Reports

Supports HR managers with group reports for candidate shortlisting and share individual reports of the shortlisted candidate with interviewers

Aon Live

Separate Product

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Sample Screenshots

Scoresheet

Number of times candidate has moved out of test window

Cyclomatic Complexity. Lower the complexity, more efficient is the code.

A	B	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU
								Programming 1					Programming 2					
Candidate Id	Name	Start Time	Time Taken	Switch Count	Switch Time	Total Score	Overall Percentage	Language	Score	Percentage	Complexity	Warnings	Language	Score	Percentage	Complexity	Warnings	
12416622	Zohan B Philip	10 Mar 2019 10:51 AM	12m 00s	0	00m 00s	8.00	100.00	C	3.00	100.00	2	0	C	5.00	100.00	6	0	View Report
12496734	Venkatesh Ellaboina	18 Mar 2019 11:20 AM	44m 49s	0	00m 00s	8.00	100.00	CPP	3.00	100.00	7	0	CPP	5.00	100.00	12	0	View Report
12496773	G Ravi Teja	18 Mar 2019 11:21 AM	44m 19s	0	00m 00s	7.75	96.88	CPP	3.00	100.00	1	0	C	4.75	95.00	8	1	View Report
12416633	Abhijith Pegallapati	10 Mar 2019 10:54 AM	44m 50s	12	02m 44s	0.00	0.00	CPP	0.00	0.00	16	1	-	0.00	0.00	-	0	View Report
12416616	Arun Rony	10 Mar 2019 10:54 AM	42m 42s	11	02m 49s	0.00	0.00	Java	0.00	0.00	9	0	-	0.00	0.00	-	0	View Report

At the same score of 100%, Zohan's code is more efficient based on complexity and # warnings

Total time spent outside the test window

Programming language used

Number of warnings thrown while execution. Lower the warnings, better is the code

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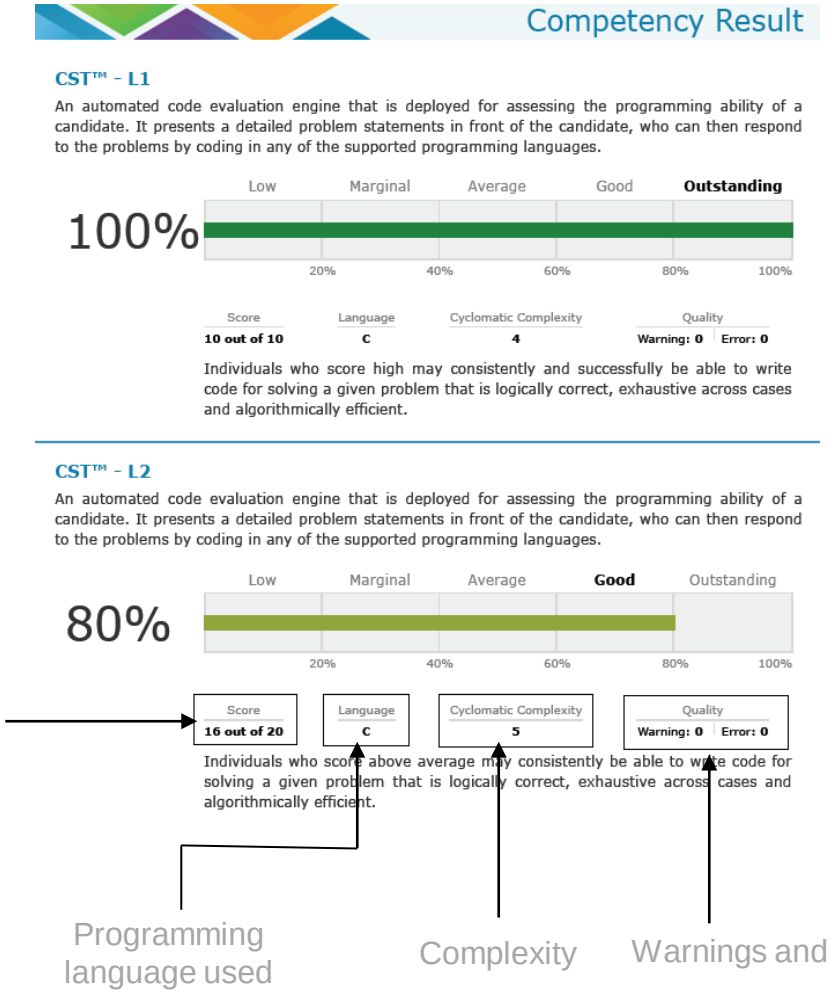
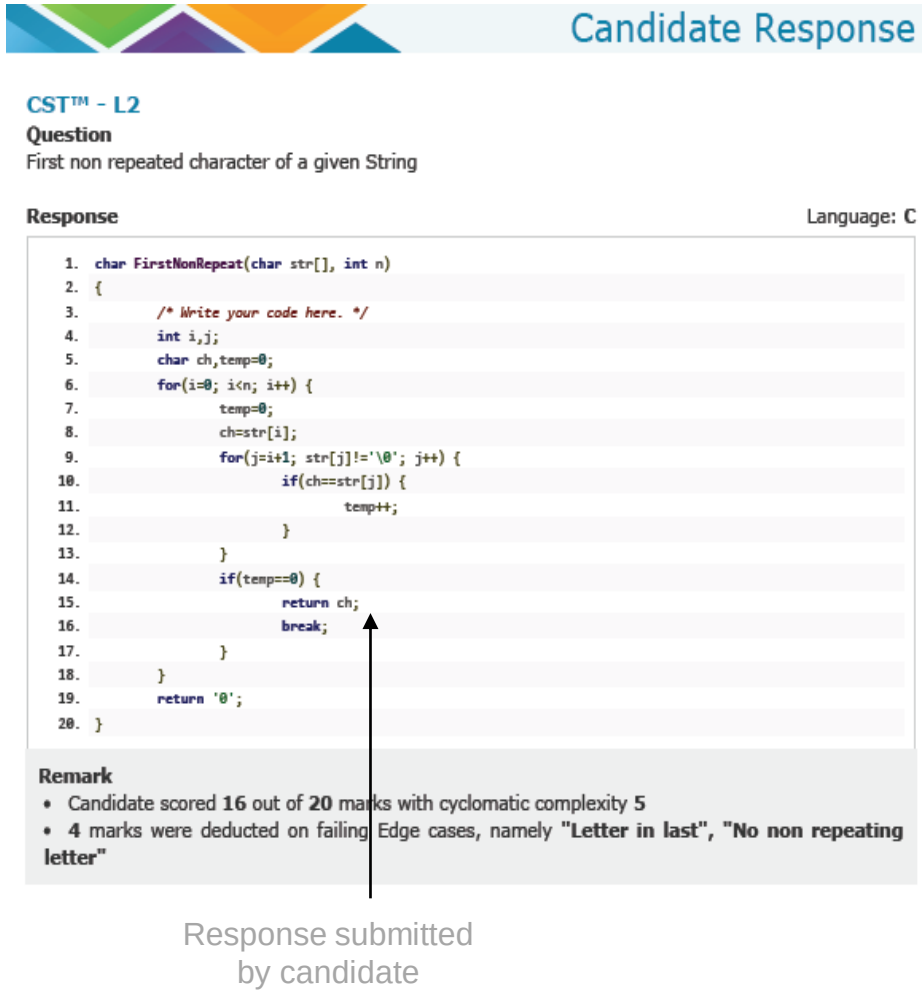
Sample Screenshots

Competency result



Candidate responses



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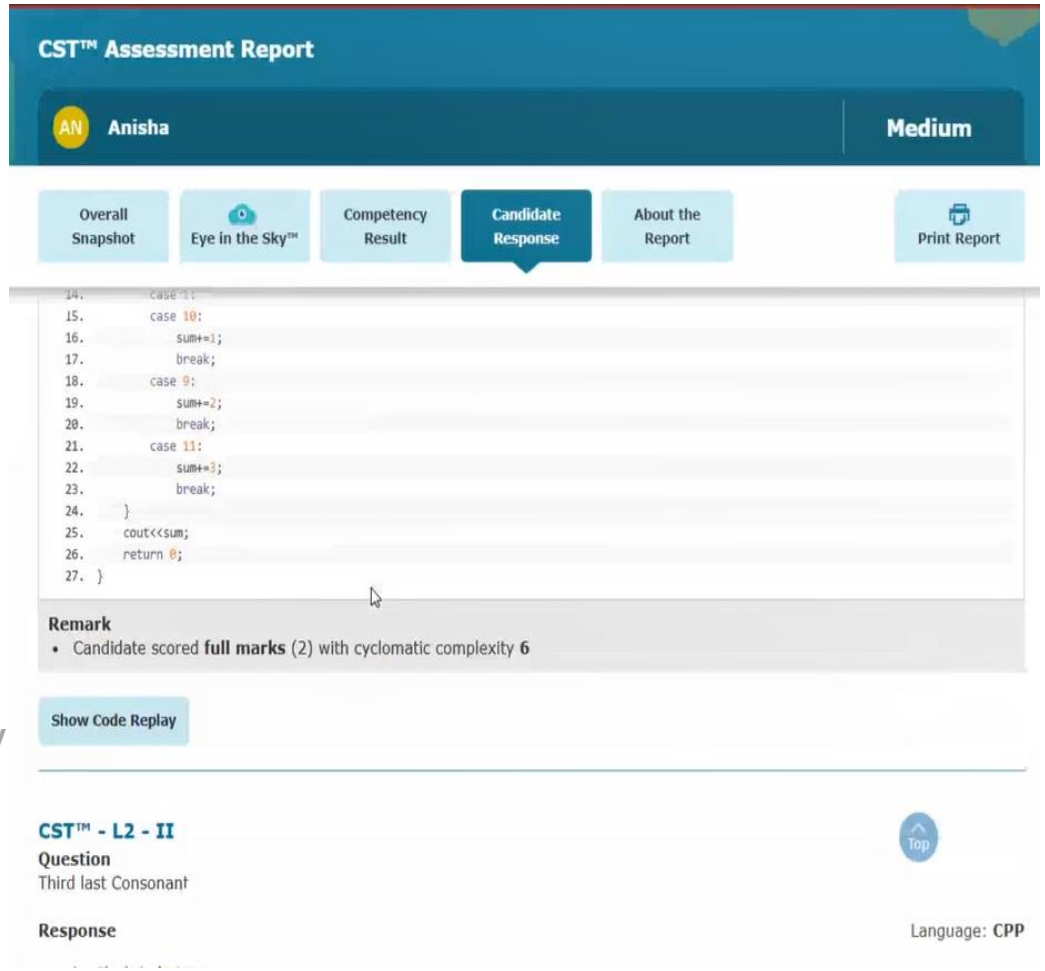
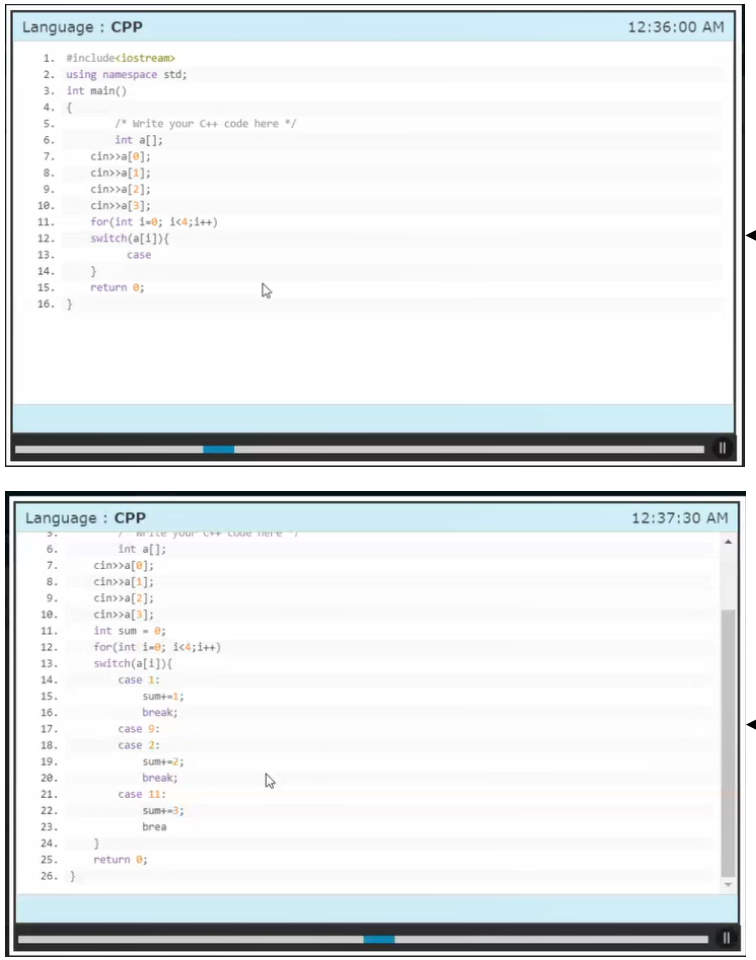
Code Replay

Code Replay is a reporting functionality wherein candidates' coding session is recorded in a video format and its snapshots are provided in the PDF report, as well. It can help in understanding the approach taken by the candidate to arrive at the final solution and in identifying if any malpractice has happened while writing the code.

Code Replay





Snapshots of code replay video of candidate's code at different intervals

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EITS 2.0

Enabling Remote Proctoring

- Advanced Remote Proctoring Tools
- Assessment Content Refresh Frequency
- Data Validation through Hiring reports
- Gamification of Assessments

EYE IN THE SKY 2.0

Advanced remote proctoring solution to identify & prevent malpractice

Face Detection & recognition	Impersonation Detection	Multiple face detection	Real Time Video/Audio Feed	Object Detection
Multiple Login	Answer Behavior	Integrated Chatbox	Low Internet Bandwidth	Any type of device

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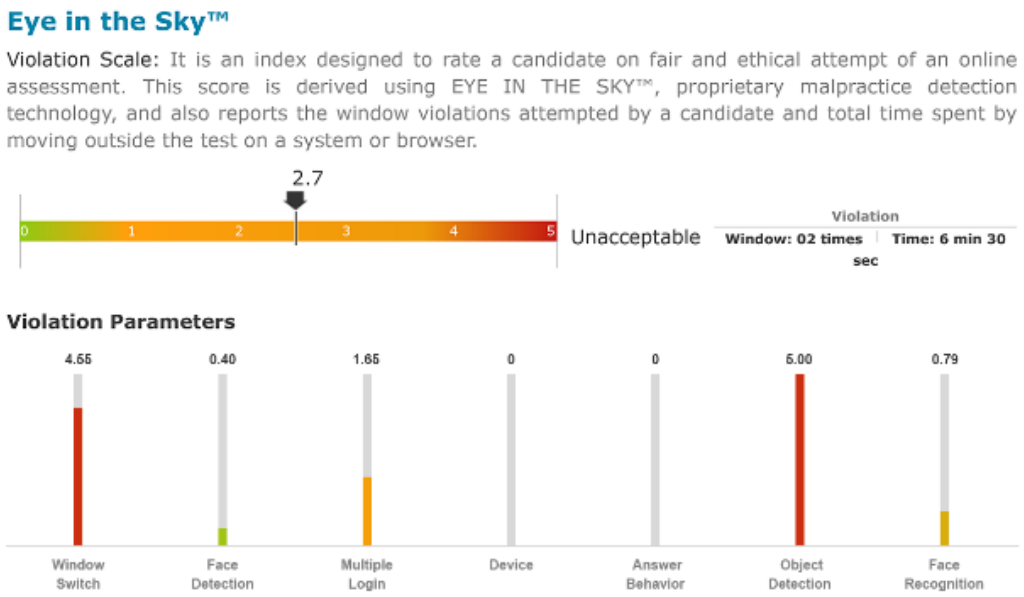
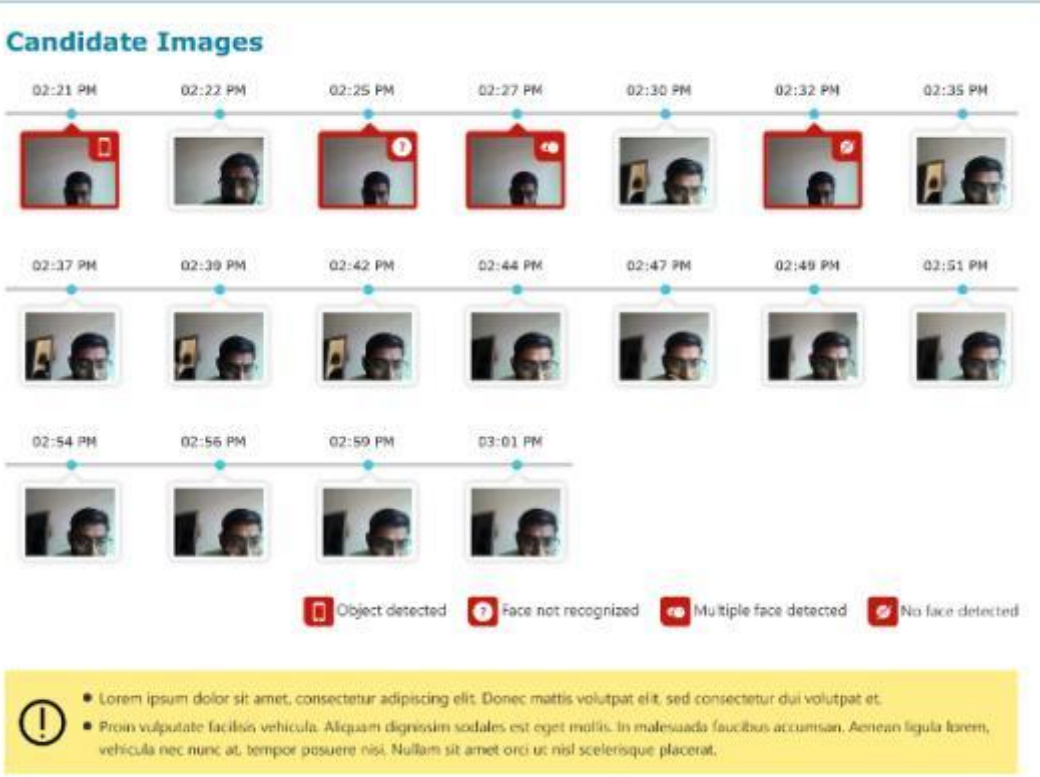
EITS 2.0
Sample Screenshots

Violation Scale and Violation Parameters



Moderate (2 - 3)
A moderate violation rating may not always be a cause for concern as candidates sometimes need to move out of the window for a short duration for troubleshooting reasons. In case this rating coincides with an unusually high score on skill, knowledge assessment, candidate should be probed in the interview around for the same. In case of a webcam monitored assessment, candidates images can be used to further investigate the situation.

Candidate Images with flags



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Case Study and Assessment Validity

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Case Study (1/2)

Predictive Validity of Coding Assessment

American multinational technology company

Case Study

Wider candidate outreach, and improving the interview-to-offer ratio

Challenge:

- Select software engineers with extraordinary programing skills

Solution

- Custom developed assessments with combination of 2 high complexity problems
- Assessments were conducted for 4700+ candidates assessed across 2 countries for 3 business units
- Proctored assessments at 64 different locations whereas 500+ take from home assessments for which EYE IN THE SKY used to improve governance

Outcomes

- Coding Scores were found to predict offers 5X better compared to academic scores
- **Strong Positive Correlation** between assessment scores and selection rate

Coding platform was liked by **82% candidates**

400+ offers were made across business units

Case Study (2/2)

Predictive Validity of Coding Assessment

British multinational investment bank & financial services company

Case Study

Efficient scheduling and high predictive validity of assessment

Challenge:

- Select female software engineers with extraordinary programing skills
- Hiring being done during post placement cycle – leading to already placed available pool

Solution

- Custom developed assessments with combination of 2 high complexity problems
- Sourcing of pre-assessed candidates through CoCubes® model to increase outreach
- IITs/NITs and other top campuses targeted for on-campus placements

Outcomes

- Offer target overachieved by **1.2x** within 2 months
- **Strong Positive Correlation** between assessment scores and selection rate

176 offers made with requirement of only 150 candidates

Jump of 1.8X in offer ratio for top quartile candidate pool basis performance vs. bottom quartile pool

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Adverse Impact and Differential Validity

Adverse Impact (Gender)

Group	Applicant Pool	Selects (above 50% score)	Selection Rate	Adverse Impact (4/5th Ratios)
Male	44,368	15,223	34.3%	**92.0%**
Female	25,611	9,523	37.2%	NO

Differential Validity

Group	n	Mean (% Score)	Standard Deviation
Male	44,368	11.5%	23.1%
Female	25,611	10.6%	21.0%

**Currently, we have adverse impact and differential validity based on gender only, it is still under process for race and other groups*

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Thank You!

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