

NUS SOC Summer Workshop 2021


AI & Media

Video Streaming with DASH Development Course Information

Pre-requisites

 Which year of study is appropriate for your topic?

2nd and 3rd year.

 What background and programming languages are required for your topic?

In general, we assume students have already have good experience with basic data structures and programming experience with a programming language such as Java or C/C++. In this workshop programming will be done in a web browser (e.g., Google Chrome) in JavaScript, however, no prior JavaScript knowledge is required, but students should be familiar with a related programming language (e.g., Java, C/C++). On the server students have choice of PHP or Python and some knowledge in HTML/HTTP is beneficial.

To take this workshop, a student must have:

- taken two or more programming and data-structure courses,
- programmed with Java or C/C++, and
- have good software development skills

 What do you think is attractive/unique about your topic to students?

Video streaming is now about 80% of all the data traffic on the Internet and there are several very large companies providing streaming services (Tencent, TikTok, Youku, YouTube, Netflix, Amazon, Hulu, Twitter, Facebook, Twitch, etc.). Therefore, knowledge about video streaming is important for computer scientists. In this course the students will learn about the fundamentals of video streaming and in the project they will build their own system with the latest techniques, specifically DASH (Dynamic Adaptive Streaming over HTTP) which is an industry standard and is supported by a large group of companies as part of the DASH Industry Forum. We will also look at some advanced topics such as 360-degree video streaming and low latency live streaming.

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Learning content and Teaching

What will be covered during “trial” lectures?

The trial lectures will provide more details about the class organization and an introduction and overview of video streaming on the Internet. Specifically, we will cover the following:

- Introduction to the module
 - o Introduction of the lecturer and the teaching assistant
 - o Introduction about video streaming on the Internet, specifically, an introduction to DASH (Dynamic Adaptive Streaming over HTTP)
 - o Description of what will be covered in the module
 - o Introduction of the group project and the related resources (server, tools, etc.)
- Introduction to image and video compression
 - o How do the fundamental image (e.g., JPEG) and video (e.g., MPEG) compression algorithms work?
 - o What are the important aspects of video compression that we need to know for video streaming?
 - o What are the best software tools to work with modern video codecs (e.g., H.264, H.265) and what are the important video file formats?
- An overview of different types of video streaming
 - o Push-based versus pull-based video streaming
 - o Streaming protocols: RTP/RTSP/RTCP versus DASH
 - o Video conferencing: WebRTC
 - o DASH and how to make video streaming adaptive
 - o Low latency live streaming

What will be covered during the “advanced” seminars?

In the advanced seminars we will look at additional exciting video streaming areas that are of much interest in the industry today, such as:

- Low latency *live* streaming. There is a lot of interest by some of the biggest video streaming companies on how to support live streaming with short latency (for example to live stream gamers). We will look at the newest technologies in this area.
- 360-degree video streaming. It is now possible to capture 360-degree videos with special omnidirectional cameras, but streaming these large videos requires special techniques and tricks and we will learn about the latest methods.

Point-cloud streaming. There is recent, fascinating work on capturing and streaming 3D people and objects and stream them as so-called point-clouds. This is the one of the most cutting-edge trends today.

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👻 What will be the nature of the project work? How do you intend to split students into project groups, each consisting of 3 or 4 students?

There will be a group project with groups of 3-4 students each. The groups may be formed randomly or with the students' input. Each team will build a fully working video streaming system that utilizes the modern DASH standard (Dynamic Adaptive Streaming over HTTP). The project has two components: (1) The first part is to take an input video and make it ready for streaming on a server with different representations. We will provide the server and the tools and the students will learn how to use the tools to prepare the videos and build a modern streaming server. (2) In the second part the students will learn about the dash.js video player and they will make changes; specifically, they will implement a different bitrate adaptation logic (also called an ABR algorithm) which allows the video player to work well under different networking conditions. All the teams will use the dash.js framework, but they will choose a different ABR algorithm to implement. At the end of the project the teams will have a fully working video steaming system that can work well in (i.e., adapt to) different networking environments such as mobile, cellular or WiFi. The students will be advised by the professor and a very knowledgeable teaching assistant when working on their projects.

👻 Do you have any recommendations for references (books) students can study to prepare for your topic before coming to NUS?

The students can prepare by looking at the DASH (Dynamic Adaptive Streaming over HTTP) standard and some introductory materials:

- Thomas Stockhammer. 2011. "Dynamic adaptive streaming over HTTP --: standards and design principles." In the second annual ACM Conference on Multimedia Systems (MMSys 2011). pp. 133-144. DOI: <https://doi.org/10.1145/1943552.1943572>; <https://dl.acm.org/citation.cfm?id=1943572>
- https://en.wikipedia.org/wiki/Dynamic_Adaptive_Streaming_over_HTTP

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- 👤 Besides their own personal laptops, what other equipment or software would students need for your topic?

The students will be doing a project which is built upon the dash.js video player, which is a modern video player written in JavaScript and running in web browsers. Some of the software that the students will be using is:

- dash.js <https://github.com/Dash-Industry-Forum/dash.js>
- FFmpeg <http://ffmpeg.org>
- MP4Parser <https://github.com/sannies/mp4parser>
- MP4Box <http://www.videohelp.com/tools/mp4box>

The students will get knowledge in these tools which are used in industry today. We will provide a server on which the students can build their video server.

Assessment

- 👤 What forms of assessment will there be?

There will be 3 assessments:

- 1 Short Quiz: There will be one short quiz to make the students familiar with the Test format. This will only take about 20 minutes. (Weightage: 5%)
- 1 Test: This will be about 1 hour and cover the material that will be presented in several lectures during the 2-week period. (Weightage: 45%)
- 1 Project: As part of this module the students will build a working streaming system in groups of 3 or 4 students. At the end of the summer school there will be a group presentation and demonstration in class. (Weightage: 50%)