**Subject Number(s)**
4.570 (H) /4.550 (UG)

**Subject Title and Subtitle**
Computation Design Lab: Design Experience Workshop (Augmented, Immersive and Mobile Kyoto)

**Term offered**
Spring 2020

**Instructor(s)**
Prof Takehiko Nagakura
- Collaborator/Host of Fieldwork: Prof. Ryusuke Naka (Kyoto Institute of Technology)
- Collaborator: Boston Museum of Fine Arts, Arts of Japan Department
- Fieldwork Funding Support:
  - MIT MISTI Hayashi Fund
  - Kyoto Institute of Technology, D-Lab
  - MIT-SUTD IDC Research Fund

**TA(s)**
Yichen Jia

**Credit Units**
2 – 2 – 8 = 12 units

**Level**
4.570 (H) /4.550 (UG)

**Prerequisites**
There is no specific prerequisite, but students are expected to have a background in computation, architectural history, spatial design, or media arts, and familiar with basic 3D modeling process. Knowledge of programming/scripting skill would be an advantage but is not necessary.

**Schedule**
Lecture/Review: Mon 11:00-2:00, Room 8-205
Lab and Seminar: Tue 7:00-9:00pm, Room 3-329

**Subject Description**
Have you ever been to Japan’s ancient capital, Kyoto? Is there a good way to represent or exhibit the experience of important locations by using contemporary technologies such as mobile apps, or virtual and augmented reality? Can such a way enhance the visitor’s experience in a museum where actual artifacts are presented by removing them from their original spatial context?
This workshop is a revised sequel to the seven previous Digital Heritage subjects in the spring of 2013-19, in which students conducted fieldwork using on-site digital recording/3D captures and developed AR, VR and other digital representation prototypes, while studying historic architectural places and urban.
designs. The class this year will collaborate with the Japanese Art section of Boston MFA (Museum of Fine Arts) and target to design interactive and immersive exhibits, that combine MFA's Japanese Art collection and the recordings the class will make on the sites of prominent temples and shrines in the historic Kyoto/Nara area in Japan. At the end of the semester, each student team is expected to present its design proposal that digitally unites the isolated piece of Art collection with the original spatial context where the piece came from.

The workshop will combine digital technology, history and architecture for design pedagogy and exploratory research, and provide opportunities to develop online/offline prototypes representing the place, community and its history for visitors, through applications of recent digital methods. They include photogrammetric modeling, panoramic video, game engine, drone, HMD, AR, VR, and mobile application. The class is run by collaborating architects, historians, and technology experts from MIT as well as Kyoto Institute of Technology, which will host our visit during the spring break. It is open to all motivated students, graduate and undergraduate, in Architectural and Urban Design, Computer Science, History, Media Arts, Anthropology and other relevant fields. Our goal is to rethink architecture, and to redesign its experience.

Sponsors
MIT MISTI Japan Hayashi program
Kyoto Institute of Technology, D-Lab
SUTD-IDC Research Grant

Field Trip and Cost
The class will visit Kyoto/Nara, Japan, and near-by area during the spring break on a sponsored trip. Those who will not be able to participate in this trip should not take this class. The cost of standard flight, local transportation for the class activities, and accommodation is covered by the sponsors of the class, but each student is responsible for food during the trip. The airline ticket needs arranged by each student individually, and the cost will be reimbursed after the field trip to a fixed amount. The first part of the trip will be used primarily for group activities including communal data collection and visit to major historic sites, and the remainder will be used by each team to serve the need of a respective research project proposed, such as scanning, interview, visual recording, and audio sampling on a proposed site.

Expected activity locations: 1. City of Kyoto (Arashiyama district, Higashiyama district, Karasuma district) 2. Miidera Temple (National Heritage Site, Shiga prefecture) 3. Nara (Horyuji and Todaiji temples) 4. Locations proposed by each group will be evaluated and selectively added.

**List of Subject Objectives**

- Ability to research and represent an art/architectural heritage and historic places
- Learn and practice fieldwork methodology for capturing spatial forms and events
- Learn history of architecture in Japan
- Explore means to deliver digitally enhanced architectural representation online, on-site, or in museum setting

Example of projects include:
- Use of photogrammetry/RGBd tools on-site for digitally capturing built forms, texture, as well as movement of people
- Construction and interface design of multi-disciplinary database of text, artifact, form, texture, drawing, photography, and video
- Interactive educational tool that uses game engine and helps museum visitors to learn the history and architecture of the heritage
- Mobile application: augmented reality on site or in museum for visualization of demolished, incomplete or hidden state of the building
- 3D panoramic/stereographic delivery of immersive, VR experience in built/un-built spatial design
- Mining big data for analysis and visualization of the heritage as it exists in the mind of people

**Evaluation Criteria**
There will be a series of four short exercises of 1 week at the beginning of the semester and another in April, in which each student will become familiar with the context of museum presentations; historical/geographic context of Japanese art and architecture; application of contemporary technology such as photogrammetric capturing, panoramic video, game engine, drone, VR, AR and mobile application; and investigation into digital heritage research and theories. This will be followed by a final project proposal, field work, and the final project development. The main requirement for the final project is to develop a design proposal for presenting Japanese Art collection of MFA, in the form of a prototype that combines the physical exhibition space and artifacts with digital recordings from the sites of the fieldwork. Application of the interactive and/or immersive technologies such as AR, VR, and mobile app are encouraged, and the students are expected to explore different technology options through the design development. Data sampled during the previous expeditions by Nagakura’s research team in Kyoto will also be made available for those interested. The design proposals created by the student final projects will be reviewed at the end of the class with MFA curators invited as guests. Limited funding will be available for hardware, software, or materials, if necessary, to support the development and testing of prototyping and development. All assignments are expected to be executed by a team of 2-3 students. It is encouraged to make the final project in a team of 2-3 students, but a solo project is permitted upon consultation with the instructor. The final review of the class will be held during the final exam week of the semester.

Class participation: 10%
Short exercises (5 assignments): 25%
Communal activities: 10%
Project Development: 20%
Mid-term review: 5%
Final review: 30% (Participation is required.)

**Schedule of Exercises, Projects, Quizzes, Exams or Assignments**

**Weekly Schedule**

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<thead>
<tr>
<th>Week 01</th>
<th>Mon, Feb. 3</th>
<th>No class.</th>
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<tr>
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<td>Tue, Feb. 4, 7pm</td>
<td><strong>Ex0 out</strong>: Introduction and Q/A, Student Selection</td>
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<tr>
<td>Week 02</td>
<td>Mon, Feb. 10, 11am</td>
<td>Meeting with MFA curators and specialists</td>
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<td>Tue, Feb. 11, 7pm</td>
<td><strong>Ex1 out</strong>: Ethnographic Study of Heritage Places and Architecture in Museums</td>
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<td><strong>Airline tickets for field-trip is expected to be purchased during this week.</strong></td>
<td>Project ideas, Past Work Examples</td>
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<td>Week 03</td>
<td>Mon, Feb. 17, no class</td>
<td><strong>Presidents Day Holiday</strong> (All Monday classes shift to Tuesday)</td>
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<td>Tue, Feb. 18, 11am</td>
<td><strong>Ex1 in</strong>: Review</td>
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<td><strong>Ex2 out</strong>: Photogrammetric Modeling (Recap/Metashape) and narrative</td>
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<td>Week 04</td>
<td>Mon, Feb. 24</td>
<td><strong>Ex2 in</strong>: Review</td>
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<td><strong>Ex3 out</strong>: Game Engine/AR/VR (Unity3d, Vuforia, ARcore/kit)</td>
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<td>Cultural heritage projects and new technologies</td>
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Visit VR Lab (by sign-up)  
Unity3D intro. by YJ * TN will be out of town.

**Lab**  
**Tue, Feb. 25**  
Week 05  
Mon, Mar. 2  
Introduction to Japanese Art and Architecture  
**Ex3 in:** Review  
**Final project introduced**

**Lab**  
**Tue, Mar. 3**  
Week 06  
Mon, Mar. 9  
Brainstorming of Student Projects (Title, Initial Idea)  
**Final project proposal review 1** (method, deliverable, resource needed, and precedents)  
Panoramic images and narrative

**Lab**  
**Tue, Mar. 10**  
**Week 07**  
**Mon, Mar. 17**  
**Ex4 out:** Panoramic Photo/Video (Oculus, Google Cardboard)  
**Ex4 in:** Review

**Lab**  
**Tue, Mar. 18**  
**Week 08**  
**Mar 22 – March 29**  
Field Trip to Kyoto/Nara, Japan during the spring break

**Week 09**  
**Mon, March. 30**  
Data retrieval, Report on the trip outcome  
(Screening recorded video/photo/model)  
**Ex5 out:** Research practice in digital heritage

**Week 10**  
**Mon, Apr. 06**  
Project Re-calibration  
**Ex5 in:** Review

**Week 11**  
**Mon, Apr. 13**  
*Patriots Day Holiday* (including Tue, Apr. 16)

**Week 12**  
**Mon, Apr. 20**  
Final project mid-term review

**Week 13**  
**Mon, Apr. 27**  
TBA/Workshop

**Week 14**  
**Mon, May 4**  
TBA/Workshop

**Week 15**  
**Mon, May 11**  
Mock-up preview of final presentation  
**Thurs, May 12**  
*Last day of class at MIT*  
May 15-20  
**Final project final review** during exam week

**Textbooks and Reading Sources**

All materials are provided online from the resource section of the class home page as links to text, video, and interactive media. The followings is a snapshot of that resource section.

[West Meets East: Japan (and its architecture) from the eyes of foreign visitors]

- Houses and People of Japan, Bruno Taut (1936): copy on class Stella site: Taut (1880-1938) visited Japan near the end of his life and wrote an influential books on Japanese architecture and culture in general including Katsura Imperial Villa.  
  [https://archive.org/details/impressionsjapa01cramgoog/page/n322](https://archive.org/details/impressionsjapa01cramgoog/page/n322)
- Impressions of Japanese Architecture ( here , or here ) by Ralph Adams Cram (1905), and reprinted version (free if you access from within MIT library site): Cram (1863-142) was the former head of MIT's Architecture, who visited Japan and wrote this book about Japanese traditional architecture such as Horyuji Temple in Nara . He designed House of the Rising Sun before his visit to Japan.
- Scarpa and Japan Exhibition Carlo Scarpa and Japan's Guiding Influence
- Travel Wright Japan through the Eyes of Frank Lloyd Wright
- Ernest Fenollosa (1853-1908): Former Asian Art Director of MFA. Traveled and taught in Japan (1878-1890). A converted Buddhist with his grave at Miidera Homyoin.
- William Sturgis Bigelow (1850-1926): Traveled to Japan for 8 years from 1992 and collected 40,000 arts that were donated to Boston MFA. A converted Buddhist with his grave at Miidera Homyoin.

[About Kyoto (and Nara) and its locations]
- Miidera Temple (pamphlet)
- Kangakuin Plan and interactive 3D viewer (made in Unity 3D)
- Daitokuji Ryogenin (pamphlet)
- Ryoanji Stone Garden (pamphlet)
- Introduction of Heiankyo Sousei-kan (Memorial Museum of Kyoto in Classical Times)
- Museum of Ancient Capital Kyoto (Japanese only)
- Katsura Imperial Villa: Commented by Bruno Taut and many other early visitors of Japan.
- Horyuji Temple (Nara): Commented by Ralph Cram, Taut, and many other early visitors. MFA Buddhist room was built with this temple as reference.

[Japanese Architecture and Art]
- Space and Ritual: the Evolution of the IMage Hall in Japan by Samuel Morse

[Museum, Exhibition, Archeology, Preservation, and Technology]
- How do you make an architectural exhibition? by Owen Hopkins, Acting Manger or Architecture Programme at Royal Academy of Arts
- Photo Tourism and Building Rome in One Day projects by Washington University team and Microsoft
- NYT article on Paris 3D by Dessault Systems
- Bill Mitchell, Virtual Museum (City of Bits)
- Bill Mitchell, Museum Design (AXIS Interview, partial translation into English)
- TED video on CyArk project by Ben Cacya with his laser-based 3D scanner and the site of CyArk, his digital preservation organization
- MIT project on Syrian Digital Heritage on a article in Boston Magazine and the site of #NEWPALMYRA
- PBS NOVA program introduction of The Technology That Will Resurrect ISIS-Destroyed Antiquities and interview with ICONEM’s architect, Yves Ubelmann. Other materials are here and here.
- Graham Foundation article on Peter Eisenman’s exhibition on Palladio at Yale and introduction by Anthony Vidler
- Google Art Project: Morgan Library Tour (NY)
- aero3Dpro.com Site of the company specialized in high-resolution point cloud models with texture of urban fabrics produced from aerial and ground based photographs. More examples on YouTube available here and here.
- Replica of Art and Architectural objects such as Sacozzi’s column for sale
- AR Museum example Srbija 1914 and Srbija 1914 (short version)
- AR Museum example Seeing Objects Moving
- Russian Photogrammetric Modeling Posting Platform Sputnik with LoL (Level of Details) technology
- CityEngine for 3D GIS
- OpenStreetMap and related tools such as MapBox
- AR Mail from Harbin: a recent digital heritage project at TN’s lab
- CyArk NGO project (founded by Ben Kacyra, an inventor of LiDar) to scan and make 3D online library of endangered heritage sites and introduction in Google Arts and Culture. Its founder Ben Kcyra is an inventor of a portable LiDar system later acquired by Leica.

[Tools for the workshop projects]
- Autodesk Student Site for downloading free software including Recap and Revit
- Autodesk 360 cloud service for simulation and visualization
- Unity3D game engine (free version available)
- Open Locast and its development tool for location based information management system developed by Federico Casalegno’s team at MIT
- Syntheyes Camera Tracking software and demo (with Blender) on Vimeo
- GoPano lens and converter tool for 360 panoramic photo/video recording. And here is some tips for recording. Also, here is a beta version tool for embedding the panorama video in Flash-based webpage.
- Hand-held 360x180 panorama photography explained in a youtube video (You do not need a special equipment for this process.)
- Decrease of Vertical Motion (Great illustration of walking without much vibration with handheld)

[Panoramic video: See this link for reference.]

[Tools for 3D Capture/AR]
- Structure Sensor Site of the company who develops mobile scanning device system with the same RGBd camera (PrimeSense Carmine sensor) as Kinect uses.
- ARmedia Geo-located Augmented Reality Player
- 123D Capture / Recap: Visit this page for reference.
- Kangakuin viewer by Nagakura

[Drone]
- DJI drone Phantom and Mavic
  - video narrative example (Nagakura): St. Sophia Cathedral in Harbin
  - video narrative example (Nagakura): Monticello from the Air

[Travel]
- Video Diary from 2019 field trip.
- Kyoto Location Map (Nagakura version 2017, 2019)
- Kyoto Location Map (Kikuchi version 2018)
- Design Heritage Patchwork from Nishik to Kiyomizu Temple
- Schedule (Subject to Change) for 2020 workshop
- KIT Campus Map KIT official site version and annotated version by Nagakura
- College House Matsugasaki (for 2020 field trip) Japanese site only

Lab Fees (if any)
None