

Instructor	Sanjiv K. Bhatia
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e-mail	sanjiv@umsl.edu
urls	http://www.cs.umsl.edu/~sanjiv http://www.cs.umsl.edu/~sanjiv/classes/cs6420
Office Hrs	T Th 4:00pm – 5:30pm Any other time by appointment
Prerequisites	Cmp Sci 5420 or consent of instructor

Welcome This is a course about advances in computer vision and image processing. You will learn advanced topics and algorithms in computer vision building on your knowledge from CMP SCI 5420. You'll be working in OpenCV extensively to implement the projects.

This course is a continuation of Cmp Sci 5420 from Fall 2020. We will study the algorithms for frequency domain processing, wavelets and multiresolution processing, image restoration, and segmentation. In addition, we'll look at the current research in image processing and computer graphics. Every student will select a project of his/her own choice and get it approved by me. Then, the student will study and implement the project and make a presentation to the class.

Teaching Philosophy I believe in learning by doing things. Thus, I'll be assigning a number of projects to solve problems in Computer Vision. I'll be happy to help any student who gets stuck while working on the project. I am comfortable in working with major platforms such as Windows, Linux, and Mac. However, I have mostly worked in C++. I allow the students to work in a language of their choice (Java/Python/C++) but due to my limited experience, I'll be able to provide low-level help only in C++. You are welcome to schedule a zoom meeting at any time, or send me an email to discuss any issue related to class, or even related to your career.

Course Description This course covers new developments in digital image processing, computer vision, and multimedia. Topics to be covered may include image databases, object tracking, and large-scale data visualization.

Required text

- Gonzalez and Woods. *Digital Image Processing (4th Ed)*. Pearson. 2018.
- You can learn about OpenCV from the web site <https://docs.opencv.org/> (there are some tutorials available) or from one of the OpenCV books.

Topics

- Frequency domain processing of images
- Wavelets and multiresolution processing
- Image restoration
- Image segmentation

Outcomes At the end of this course, you are expected to independently undertake and implement a research-oriented project in image processing successfully. You should understand various image processing tasks and the algorithms required to execute those tasks.

Goals of the course This is an advanced course in image processing and computer vision. You will apply the skills learned to analyze an image as an expert. You should be able to summon the necessary algorithms and data structures to solve a problem in computer vision. Specifically, you should be able to segment an image, identify the pixels for different objects in the image, and process video.

Blended Learning This is a blended course. It is designed to integrate in-person and online modes of learning to fully engage you with me, course content, and other students to accomplish our course goals supported through in-person and online content and activities and assessments best suited for in-person and online. Each online and in-person component of our course will enrich your learning experience to provide you with opportunities for variation and practice, active learning and interaction with your fellow students.

Time Requirements for Our Blended Course This is an active, blended class with synchronous twice a week meetings complemented by online learning experiences in Canvas in between class meetings. Our course is a 3-credit hour course and requires 3 hours of your time each week in addition to the time it takes you to read the required materials, watch the videos, and complete the assignments. That means that you need to plan to spend a minimum of 6 hours every week (up to 9-10 hours a week) on activities related to this course. If you would like to explore how the online Canvas activities work, please consult the Online Canvas Overview course (<https://umsl.instructure.com/courses/15933>) in Canvas where you can practice posting to a discussion board, take a practice quiz and more.

Technology Requirements: As a computer science major and a student in a blended course, you are expected to have reliable internet access almost every day. Please reach out to your academic advisor or student success network if you need hardware or access to the Internet. If you have computing problems, it is your responsibility to address these through the ITS Helpdesk (helpdesk@umsl.edu) or to use campus computing labs. Problems with your computer or other technology issues are not an excuse for delays in meeting expectations and missed deadlines for the course. If you have a problem, get help in solving it immediately from <http://www.umsl.edu/technology/support/>. At a minimum, you will need the following software/hardware to participate in this course:

1. Computer with an updated operating system (e.g. Windows, Mac, Linux)
2. Updated Internet browsers (Google Chrome (required) or Mozilla Firefox)
3. Ability to navigate Canvas (Learning Management System)
4. Minimum Processor Speed of 1 GHz or higher recommended.
5. OpenCV library. If you do not have enough resources to install OpenCV, you will be able to use the installation on a campus machine (possibly, hoare).
6. Reliable and stable internet connection.
7. Adobe Reader or alternative PDF reader (free)
8. A webcam and/or microphone is *highly recommended*.

How to Succeed in This Course I truly believe in your success as a student and adapting my instruction to ensure your success. Below you will find several different instructional methods to help me accomplish my goal:

- I'll like good participation in the course. Therefore, I am allowing 5% points for participation. To have objectivity, I'll expect you to give me a one-minute audio-visual report every week on what you learned that week. You can also say things about what is going well with the course and what needs improvement. The comment will come using a tool called *Voice Thread*. The use of web cam will allow me to put a face to your name. You will receive 1 point for submitting the voice thread every week. At the end of the semester, all of the points will be aggregated towards 5% of your grade. Since the class meets on Tuesday/Thursday, I can reasonably expect the comment by Sunday midnight. I will not accept any late submission on this and so, please submit this diligently.
- The lectures will cover theoretical aspects of the course. I'll be happy to help you with any issues related to the OpenCV library as long as they are in C++. For other languages, I'll give you ideas but you'll have to work on your own. Of course, you can always ask me questions, or help with debugging the code outside of class (office hours or otherwise).
- The lecture notes will be available to you in the form of PDF documents. You can print those and annotate on them during lectures. You do not need to take too many notes during lectures.
- It will be nice to see some discussions on Canvas regarding the material discussed in class, or even on new technology that you come across.

If this is your first blended or online course, it is recommended that you log into Canvas and complete the Online Course Overview listed in your Canvas course list. If you've already completed the orientation, you do not have to retake it but you can refer to it for helpful videos and tutorials about the technologies used in this course.

Course Plan for the Unexpected Please stay informed about university policies, instructions and resources as they relate to the COVID-19 pandemic: <https://www.ums1.edu/hcdas/coronaupdates.html>. It is important to me that you stay on track toward your degree completion. This section presents our course continuity plans for how we will handle situations to avoid disruption to your learning.

- All the lecture material will be available to you as PDF documents on the class web page and accessible via Canvas.
- I'll try my best to record and post all the lectures online, including the ones that are delivered in person.
- In case of a pivot to completely online, all the material (lectures/lecture notes) will be made available online prior to the beginning of class time.
- All the assignments will be available online. I'll ask you to explain your code to me for some of the projects via zoom.
- If I am unable to come to class due to sickness or emergency, I'll inform you before the beginning of class; possibly with enough notice that you do not have to make a special trip to campus just for the class. Please keep a watch on your email and pay attention to announcements on Canvas.

Email Requirements All correspondence should be made through your UMSL-provided email. Any unsigned email will go unanswered by me. Please do not send me any attachments without talking to me first.

Attendance For the in-person lectures, please arrive on time. Also, turn your cell phones to silent during class. I will not be taking attendance but you will be responsible for the material covered in class in case you miss it. Present in class for the online component of our course is determined by participation in an "academically related activity," i.e. submission of an assignment, assessment or discussion forum posting. The last day of attendance is the last day a student is academically participating in the blended course whether in-person or online as defined here.

Documentation that a student has logged into the Canvas course site alone is not sufficient by itself to demonstrate academic attendance. Lack of attendance in-person or submission of work in Canvas may result in an automatic course drop.

Projects You will be given programming assignments, typically a set of programs every two weeks. Assignments will be due at 11:59pm on the due date. Assignments should be submitted on `delmar` and you must demonstrate them as executing properly for proper credit. You should start working on the project as soon as it gets assigned as some of them may get tricky. If you do not know how to work on a project, see me as soon as possible for help. You can show me the code working on your machine for full credit but after you have submitted it on `hoare` prior to deadline.

Grading The grade will be based on programming projects, a test, and a presentation of current research in the field. I'll expect each of you to select a topic in computer graphics, image processing, computer vision, or multimedia, and present current research on the topic. You should search journals, or recent proceedings from Siggraph, Eurographics, or CVPR conferences and select at least one paper from within the past five years and present the paper in class. I'll also like to see an implementation of the ideas in the paper as well as a written report. If needed, I may allow two persons to combine their implementation of a topic. The distribution of grades will be as follows:

Test	15%
Paper presentation	10%
Written report	10%
Paper idea implementation	40%
Class projects	20%
Class attendance	5%

The test will be held after the spring break. I'll give you a two week notice for the test date. The deadline for approval of topic for research is February 20, 2021. You can also look at <http://scholar.google.com> for papers. Anyone desiring an EXC grade after March 31, 2021 must be passing the course at that point to get EXC.

Failure to hand in any assignment will result in an automatic zero for that assignment. If some student is unable to hand in an assignment by the deadline, he/she must discuss it with me *before* the deadline. I'll encourage you to talk to other students regarding homework but you should not collaborate to the extent that two submissions are copies of each other. If you are found copying an assignment (from another student or internet), or if your submission has *unreasonable similarity* to another submission, you get a zero for that assignment automatically. A second offense will be reported to the University officials and students involved will face serious consequences. I may ask you to come to my office and explain your code to me; in case you are not able to explain the code to my satisfaction, I'll assign you a zero in that project.

The projects in this class will take up a lot of your time. So, you should start working on those as soon as they are assigned. In the past, the students who have asked a lot of questions have scored better grades. Do not hesitate to ask a question in class, in my office, or over email, especially if you do not have an idea on how to start working on the project.

Feedback and Grading Timeline: I expect that you will have feedback and grade on your submitted projects within two weeks of submission. I'll try my best to return the graded tests to you within a week after the test. Under normal circumstances, I'll update your participation grade within 48 hours of the due date. You can find grade in the Grades button on Canvas. If there is a rubric attached to the assignment, you can click your score to see my personal feedback on the rubric.

Miscellaneous If you have any disability that requires an accommodation (as per UMSL policy), you must notify me in advance. If you cannot attend the class due to a religious holiday or a university-sanctioned event, please let me know in advance as well. In case you are down with the flu, please stay absent from the class till you recover, and

contact me via phone or email. I'll try my best to make accommodation for you in that case.

We'll be using the open source software OpenCV for the class. Please download and install it on your computer. There is an old version of OpenCV (v. 2.4) available on hoare but it is too old to be of much use.

There is only one exam and no final. You will be working on your research and presentation towards the end of the class.

Important dates

Jan 25, 2021	Last day to enroll in the course
Feb 15, 2021	Last day to drop without receiving a grade
Feb 20, 2021	Last day to submit your research proposal
Mar 15, 2021	Last day to drop the course without instructor approval
Apr 19, 2021	Last day to drop the course with instructor approval

Anyone desiring an EXC grade after October 31, 2020 must be passing the course at that point to get EXC.

Online Class Netiquette/Behavior

- Be self-reflective before you post an emotional response and reread what you have written to be sure it is positive. Think of your comments as printed in the newspaper. Your online comments will be seen, heard and remembered by others in the class.
- Use effective communication.
 - Avoid the use of all caps or multiple punctuation elements, such as !!! and ???.
 - Be polite, understate rather than overstate your point, and use positive language.
 - If you are using acronyms, jargon or uncommon terms, be sure to explain them so everyone can understand and participate in the discussion.
- Ask for clarification to a point if you feel emotional from a classmate's post. It is likely that you misunderstood their point. This strategy will also help you step away from the intensity of the moment to allow for more reflection.
- Sign your name. It is easier to build a classroom community when you know to whom you are responding.
- Foster community. Share your great ideas and contribute to ongoing discussions. Consider each comment you make as one that is adding to, or detracting from, a positive learning environment for you and your classmates.
- Be constructive. You can challenge ideas and the course content, but avoid becoming negative online. When you disagree politely, you stimulate and encourage great discussion. You also maintain positive relationships with others with whom you may disagree on a certain point.
- Keep the conversation on topic by responding to questions, adding thoughtful comments about the topics at hand. Online dialogue is like conversation. If there is a certain dialogue going on, please add to it, but if you have something new to say, please post it in another thread.
- Define your terms. When using acronyms or terms that are particular to your field (or new to our course), please define them for others.

UMSL Course Policies

1. Participation (expectations)

If you are unable to participate in the scheduled class activity or discussions, you must notify the instructor within the week of that class module or discussion. The instructor reserves the right to make judgment to accept and/or make-up assignments missed because of failed participation in the course activities.

- It is vitally important that our classroom environment promote the respectful exchange of ideas. This entails being sensitive to the views and beliefs expressed during discussions whether in class or online. Please speak with me before recording any class activity. It is a violation of University of Missouri policy to distribute such recordings without my authorization and the permission of others who are recorded.
- I will not respond to each post but will be monitoring each discussion. I'll correct if I find something that is incorrect.
- Your success in this course will heavily depend on your ability to communicate, engage and participate in all course activities. Successful completion of this course requires that a student keep up with all assignments, coursework and discussions. Timely participation in in-class and online discussions is a very important part of this course and participation in these discussions, and other activities as assigned, is not optional. You are expected to prepare and post to discussions in a timely manner consistent with the requirements contained within the course syllabus.
- **Online Discussion Guidelines**
 - Participation in the course should maintain a positive work and learning environment, as outlined in the UM Collected Rules & Regulations, 330.080
 - Postings should be evenly distributed during the discussion week.
 - Postings should be a minimum of three sentences, or one short paragraph, and a maximum of two paragraphs. Or you can give a one-minute recorded presentation.
 - Responses should be well written with proper punctuation, spelling and grammar.
 - Avoid short one-word postings, for instance, "I agree," unless accompanied by supporting statements from the readings or prior knowledge (work and life experience).
 - Stay focused on the topic.
 - Ask questions; challenge other postings that lack supporting evidence or present incorrect information.
 - Encourage further discussion by building on current threads.
 - Check your postings for responses from others and respond in kind.
 - Use proper "netiquette".
- Turn off sound on beepers, cell phones, and other devices during class. Adherence to the Student Conduct Code is expected.
- I am committed to insuring a positive learning environment by respecting that University policy (p. 66): <http://www.ums1.edu/~studentplanner/index.html>.
- Your success in this course will heavily depend on your ability to communicate, engage and participate in all course activities. Successful completion of this course requires that a student keep up with all assignments, quizzes, projects and tests.
- If you are unable to participate in the scheduled class activities, you must notify the instructor within the week of that class module. **An unexcused failure to engage or participate with the class will be counted as an absence; unexcused absences may result in failure.** The instructor reserves the right to make judgment to accept and/or make-up assignments missed because of failed participation in the course activities.

2. **Academic Integrity/Plagiarism:** We want our learning environment to be honest and fair. The assessments in our course provide you with an opportunity to showcase what you know and learn from what you may not yet have mastered. When you submit work with your name on it, this is a written statement that credit for the work belongs to you alone. If the work was a product of collaboration (such as a group project), each student is expected to clearly acknowledge in writing all persons who contributed to its completion.

Each assignment and exam in our course will include clear guidelines about the rules around each assessment including what materials are appropriate to use. It is always required that the work you submit is your own, uses proper citation, avoids collusion or falsification.

If you have a question about an assignment, do not hesitate to contact me for clarification. You are responsible for being attentive to and observant of University policies about academic honesty as stated in the University's Campus Policies and Code of Student Conduct found in the UMSL Bulletin.

- **Plagiarism, collusion, cheating, and falsification are not acceptable** and will result in failure of an assignment and possible administrative sanctions such as dismissal from the university.

Plagiarism. Representing the ideas or work of another as your own, intentionally or unwittingly, without proper, clear, explicit acknowledgement.

Facilitation/Collusion. Supporting malpractice by another student, for example, allowing your work to be copied.

Duplication of Work. Presenting the same work for a different assessment.

Cheating. Using any unauthorized sources of information (such as previous or existing exams for this course) and providing or receiving unauthorized assistance on any form of academic work or engaging in any behavior specifically prohibited by the faculty member (e.g., uploading or using test or online homework questions on study sites such as Chegg.com, copying someone else's answers on tests and quizzes, copying/pasting exam or online homework questions from this semester for your peers or publicly in online forums).

Falsification. Any untruth, either verbal or written, in one's academic work including presenting fabricated/made up data or presenting someone else's work as your own. Unless the instructor explicitly states otherwise, it is dishonest to collaborate with others when completing any assignment or test, performing laboratory experiments, writing and/or documenting computer programs, writing papers or reports and completing problem sets.

- Academic dishonesty is a serious offense that may lead to probation, suspension, or dismissal from the University. Academic dishonesty can take a number of forms described above: plagiarism, cheating, unauthorized possession or distribution of academic materials including the unauthorized use, selling or purchasing of examinations or other academic work, using or stealing another student's work, unauthorized entry or use of material in a computer file, and using information from or possessing exams that an instructor did not authorize for release to students.
- All instances of academic dishonesty will be reported to the Office of Academic Affairs who will determine whether you will appear before the Student Conduct Committee for possible administrative sanctions such as dismissal from the university. The instructor will make an academic judgment about the student's grade on that work in this course. The campus process regarding academic dishonesty is described in the "Policies" section of the Academic Affairs website

3. Title IX Policies

Mandatory Reporting: Under Title IX, all UMSL faculty, staff, and administrators (with limited exception) are obligated to report any incidents of sexual harassment, sexual misconduct, sexual assault, or gender discrimination to the Student Affairs office and/or other University officials. This ensures that all parties are protected

from further abuses and that victim(s) are supported by trained counselors and professionals. Note: There are several offices at UMSL (e.g., Counseling Services, Health Services, Community Psychological Service, Center for Trauma Recovery, and Student Social Services) whose staff are exempt from Title IX mandated reporting, when the information is learned in the course of a confidential communication.

Student Resources Your academic success is important to me. We all learn differently and bring different strengths and needs to the class. If there are aspects of the course that prevent you from learning or make you feel excluded, please let me know as soon as possible. Together we'll develop strategies to meet both your needs and the requirements of the course.

Access, Disability and Communication If you have a documented disability that may have an impact upon your work in this class, please contact Disability Access Services (DAS) immediately. Students must provide documentation of their disability to the office of Disability Access Services in order to receive official University services and accommodations. The staff is available to answer questions regarding accommodations or assist you in your pursuit of accommodations. Information about your disability is confidential. Once DAS reviews your medical documentation, they will provide you with the information and steps to inform me about the accommodations to which you are entitled. Your accommodations will begin as soon as we discuss your approved accommodations.

- 144 Millennium Student Center
- Phone: (314) 516-6554
- Email: Tara Cramer, cramert@umsl.edu, or Adam Mann, mannad@umsl.edu
- Website: <http://www.umsl.edu/services/disabled/>

Office of International Students and Scholar Services If you have difficulty communicating in English with the instructor of this course, contact ISSS.

- 362 Social Sciences & Business Building (SSB)
- Phone: (314) 516-5229
- Email: iss@umsl.edu
- Website: <https://www.umsl.edu/global/iss/>

Student Enrichment and Achievement SEA provides comprehensive support and intervention strategies that support your road to graduation!

- 107 Lucas Hall
- Phone: (314) 516-5300
- Email: umslsea@umsl.edu
- Website: <https://www.umsl.edu/services/sea/>

Office of Multicultural Student Services (MSS) and the University Tutoring Center (UTC) MSS provides comprehensive student retention services to diverse student populations; through their tutoring center, the MSS offers comprehensive tutoring services free to students at UMSL.

- 225 Millennium Student Center (MSC)
- Phone: (314) 516-6807
- Email: multicultural@umsl.edu

- Website: <https://www.ums1.edu/~mcraa/index.html>

Technical Support Please consult UMSL's Keep Learning web resource for technology tips and help with learning in Canvas: <https://www.ums1.edu/services/ctl/KeepLearning/>

Canvas If you have problems logging into your online course, or an issue within the course site, please contact the Technology Support Center:

- Phone: (314) 516-6034
- Email: helpdesk@ums1.edu
- Website: <http://www.ums1.edu/technology/tsc/>

If you are having difficulty with a technology tool in Canvas, consider visiting the Canvas Student Guides, which has overviews of each tool and tutorials on how to use them.

If you continue to experience problems or just have questions, you can also contact the Learning Resource Lab:

- Phone: (314) 516-6704
- Email: lrl@ums1.edu
- Website: <http://www.ums1.edu/technology/lrl/>

VoiceThread

- Online Contact Form: <https://voicethread.com/support/contact/>
- Website: <https://voicethread.com/howto/>

Departmental Tutoring The department offers tutoring for up to Cmp Sci 3130, and occasionally for other courses. Please check Canvas for information.