

# Course Syllabus

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## CSC 362-01 – System Programming

Spring 2022 – Syllabus

### Course and Contact Information

Instructor:	Contact:	Office Location/Hours:
Jeronimo Grandi	<a href="mailto:jggrandi@uncg.edu">jggrandi@uncg.edu</a>	158 Petty – Tue/Thu 2:00 - 3:15 p.m.

Meeting Location:	Times:	Prerequisites:	Credits
Petty 227	Tue/Thu 3:30 - 4:45 a.m.	Grade of C or better in CSC 230 and CSC 261, or permission of instructor	3

### Catalog Description

System programming with emphasis on processes, memory management, multithreaded programming, synchronization and deadlocks, interprocess communication, parallel and distributed computing, networking, files systems, security, signals, and virtualization containers.

### Longer Description

This class is a programming-focused class, exploring how programs interact with the operating system and use system and related services. As far as programming level, you can consider it as sitting between CSC 261 (hardware and assembly language) and CSC 130/230 (higher-level programming without hard connection to the underlying system). The class will use C for programming in a Linux environment, interacting with the system through Linux system calls, the standard C library, and support libraries such as *pthread*s. The class is heavy on specifics and concrete details, and light on theory/generalities which will be covered in a later class (CSC 462 – Principles of Operating Systems).

# Student Learning Outcomes

Upon successful completion of this course students should be able to:

- Diagram basic process structure and resources, including memory segments, file handles, user/ownership.
- Use manual memory management techniques for dynamic memory allocation in a program.
- Create programs that use threads for parallel processing.
- Create programs that use network sockets for inter-system communication.
- Create programs that use message passing between different systems for distributed computing.
- Explain basic security principles, including core goals of confidentiality, integrity, and availability, and subject/object access control.
- Use virtual machines and containers for isolation.

## Topics

The following are the major topics that will be covered in this class. A detailed schedule, including references to textbook and other readings, can be found [here](#).

- Course Intro, Role of the Operating System, and Virtual Machine Use
- Working with the Bash Shell, Common Tools, and Linux Security Basics
- Programming in C
- More C Programming and C Software Security
- Processes
- Memory – Segments, Allocation, etc.
- Filesystems
- Multithreaded Programming
- Synchronization and Deadlock
- Interprocess Communication
- Networking
- Network Security and Parallel and Distributed Computing
- Signals
- Virtualization and Containers

## Textbook and Readings

The required textbook is the following, which is freely available online:

- Venkatesh, L. Angave, *et al.*, *System Programming Coursebook*  
Available at <http://cs241.cs.illinois.edu/coursebook/index.html>  
(<http://cs241.cs.illinois.edu/coursebook/index.html>)
- Additional readings will be required, and links be provided to students as needed.

# Computing environment

A Linux virtual machine image will be provided to students so that there is a uniform system environment for all students to use for class work. A computer capable of hosting the virtual machine environment using [Virtualbox](https://www.virtualbox.org/) (<https://www.virtualbox.org/>) is recommended – any modern system with at least 8GB of RAM should be fine (Windows, Linux, or MacOS systems will all work).

## GitHub and GitHub Classroom

Students must have a [GitHub](https://github.com/) (<https://github.com/>) account to do activities and submit work. We will spend some time in class going over basic Git and GitHub usage, and students will be given information on class-specific procedures to follow for this class.

## Teaching Methods and Grading:

This class will meet for two 75-minute periods per week. The first (Tuesday) class of each week will be a traditional lecture class, covering new material with discussion and instructor-run examples. The second (Thursday) class of each week will have a short introductory lecture time (approximately 30 minutes), followed by an in-class activity (approximately 30 minutes), and finally a wrap-up discussion (approximately 15 minutes). Details and grading are described below.

**In-class participation:** Students are expected to participate in class sessions, and attendance will be taken from participant list as well as in-class survey questions (questions will not be graded for correctness, just participation, so every student should answer every survey question). All in-class activities will be done in small teams, with a designated “team leader” who will be responsible for submitting the team’s work. Each student will have a single GitHub repository for all in-class activities, with new directories pushed by the instructor for each activity. Before each activity, students will do a “git pull” to update their local copy of the repository with the new activity, and the team leader will commit and push the work when finished. In-class activity submissions will also count toward each student’s attendance/participation grade. Each student gets two free “skip days” before attendance penalties are taken, but use of skip days is strongly discouraged! Since skip days are available, there is no notion of excused/unexcused absences (skip days must be used for either).

**Weekly Assignments:** Each topic will include a programming assignment. These will be due every Tuesday, using concepts from the previous week (and typically being an extension of the previous week’s in-class activity). These are collaborative, meaning you can discuss solutions with other students, but you may not copy any code or answers – all code must be typed, compiled, and debugged by you. Note that while these are primarily programming assignments, some will include written questions to answer in a file submitted with your code. Like the in-class activities, each student will have a single GitHub repository for all weekly assignments and must specifically tag each final commit to indicate that it is the final submission for grading (more information on this will be provided).

**Major Assignments/Project:** There will be 3 or 4 larger programming assignments throughout the semester that will build to a single final project that incorporates several of the class topics. These major assignments are to be done *on your own*, and you may not discuss these with other students or any other person other than the instructor.

**Exams:** There will be one mid-term exam and one final exam. The midterm exam will be **Tuesday, March 1** during the regular class time, and the final exam is scheduled according to the university final exam schedule (**TBA**).

**Final Grade Calculation:** Each student work product will be graded, and the student's final grade will be determined by assigning each category of work a weighted score according to the following distribution:

Category	Pct
Attendance/participation	10%
Weekly Assignments	30%
Major (Solo) Assignments	25%
Mid-term Exam	15%
Final Exam	20%

Letter Grade Assignment				
$[91.5, \infty) = A$	$[87.5, 89.5) = B+$	$[77.5, 79.5) = C+$	$[67.5, 69.5) = D+$	$[0, 59.5) = F$
$[89.5, 91.5) = A-$	$[81.5, 87.5) = B$	$[71.5, 77.5) = C$	$[61.5, 67.5) = D$	
	$[79.5, 81.5) = B-$	$[69.5, 71.5) = C-$	$[59.5, 61.5) = D-$	

## Policy

**Academic Integrity:** Students are expected to be familiar with and abide by the UNCG Academic Integrity Policy, which is online at <https://academicintegrity.uncg.edu/> (<https://academicintegrity.uncg.edu/>).

In weekly assignments, you may discuss the problem and solutions with other students and can help classmates debug their code. However, no code may be copied from either another student or from a website — all code submitted must have been written by you. If you do work with other students on weekly assignments, you must put their names in the assignment's README.md file (there is a place for this). Major assignments must be done on your own, and you may not discuss the assignment with anyone other than the instructor. If you need help during a solo assignment, you can (and should!) contact the instructor for help but cannot talk with another student or post something online seeking help. Sharing your own work is a serious violation of academic integrity, and if homework is copied then both the person who actually did the work and the person who copied it will be punished. Note that I use a plagiarism detection tool on submissions, and if your solution is too close to that of another student or of an online resource, you will be required to explain your solution and how you arrived at it.

Any incidents of academic dishonesty will be handled strictly, resulting in either a zero on the assignment or an F in the class, depending on the severity of the incident. Any cheating in an online exam, no matter how minor, will result in an automatic F in the class. Significant incidents will be reported to the UNCG Office of Student Rights and Responsibilities. Note that the Department of Computer Science maintains records of all academic integrity incidents, and multiple violations, even in different classes or semesters, will always result in reporting to the university and serious penalties.

**Attendance Policy:** Attendance is required, and students are expected to attend class sessions. Attendance is part of the final grade calculation, as described above. The university allows for a limited number of excused absences for religious observances. Students who plan to take such an absence should notify the instructor at least two weeks in advance so that accommodations can be made.

**Late Policy and Makeup Exams:** Assignments are due at 11:59PM on the due date and may be turned in up to 7 calendar days late with a 25% late penalty. Students with planned absences, whether for university events, religious observance, or other reasons, are expected to make arrangements with the instructor to turn in assignments or take exams before the scheduled date of the assignment or test. No assignment will be accepted more than 7 calendar days after the original due date!

Exam/test dates will be announced at least two weeks in advance, and an exam may be made up only if it was missed due to an extreme emergency and arrangements are made before the exam date. Exams may not be taken early or late due to personal travel plans.

Given the COVID-19 situation, I will be flexible and accommodating within reason, but students must inform me of any complications in advance of due dates.

**In-class Behavior:** During class time, you should be focused on the class. As so much work has moved online in the past few months, there has been a lot of attention to having a professional online presence, which is expected of your participation in this class. This includes everything from backgrounds to dress

to other activities going on in your home or workspace. While we can't control every detail in a work-from-home situation – life happens, after all – you should treat this as a professional setting and act accordingly. You should keep your microphone muted when you are not actively engaged in a class discussion. To promote a sense of community, you are asked to turn on your camera when participating in in-class work groups or when asking or answering a question in the full class setting.

**Health and Wellness:** Health and well-being impact learning and academic success. Throughout your time in the university, you may experience a range of concerns that can cause barriers to your academic success. These might include illnesses, strained relationships, anxiety, high levels of stress, alcohol or drug problems, feeling down, or loss of motivation. Student Health Services and the Counseling Center can help with these or other issues you may experience. You can learn about the free, confidential mental health services available on campus by calling 336-334-5874, visiting the website at <https://shs.uncg.edu/> or visiting the Anna M. Gove Student Health Center at 107 Gray Drive. For undergraduate or graduate students in recovery from alcohol and other drug addiction, the Spartan Recovery Program (SRP) offers recovery support services. You can learn more about recovery and recovery support services by visiting <https://shs.uncg.edu/srp> or reaching out to [recovery@uncg.edu](mailto:recovery@uncg.edu)

**ADA Statement:** UNCG seeks to comply fully with the Americans with Disabilities Act (ADA). Students requesting accommodations based on a disability must be registered with the Office of Accessibility Resources and Services located in 215 Elliott University Center: (336) 334-5440 (or on the web at <https://oars.uncg.edu>). Note that if you require testing accommodations you must make arrangements more than one week before any exam.

**Elasticity Statement:** It is the intention of the instructor that this syllabus and course calendar will be followed as outlined, however, as the need arises there may be adjustments to the syllabus and calendar. In such cases, the instructor will notify the students in class and via e-mail with an updated syllabus and calendar within a reasonable timeframe to allow students to adjust as needed.

## Covid-19 Course Syllabus Statement

As we return for spring 2022, all students, faculty, and staff are required to uphold UNCG's culture of care by actively engaging in behaviors that limit the spread of COVID-19. These actions include, but are not limited to:

- [Following face-covering guidelines](https://covid.uncg.edu/face-coverings-remain-required-at-uncg/) (<https://covid.uncg.edu/face-coverings-remain-required-at-uncg/>)
- Engaging in proper hand-washing hygiene
- Self-monitoring for symptoms of COVID-19
- Staying home when ill
- Complying with directions from health care providers or public health officials to quarantine or isolate if ill or exposed to someone who is ill
- Completing a [self-report](https://veoci.com/v/p/132667/workflow/fs2x25pzqnd5) (<https://veoci.com/v/p/132667/workflow/fs2x25pzqnd5>) when experiencing COVID-19 symptoms, testing positive for COVID-19, or being identified as a close contact of

someone who has tested positive





- Staying informed about the University's policies and announcements via the [COVID-19 \(https://covid.uncg.edu/\)](https://covid.uncg.edu/) website

Instructors will have seating charts for their classes. These are important for facilitating contact tracing should there be a confirmed case of COVID-19. Students must sit in their assigned seats at every class meeting. Students may move their chairs in class to facilitate group work, as long as instructors keep seating chart records. Students should not eat or drink during class time.

A limited number of disposable masks will be available in classrooms for students who have forgotten theirs. Face coverings are also available for purchase in the UNCG Campus Bookstore. Students who do not follow masking requirements will be asked to put on a face covering or leave the classroom to retrieve one and only return when they follow the basic standards of safety and care for the UNCG community. Once students have a face covering, they are permitted to re-enter a class already in progress. Repeated issues may result in conduct action. The course policies regarding attendance and academics remain in effect for partial or full absence from class due to lack of adherence with face covering and other requirements.











For instances where the Office of Accessibility Resources and Services (OARS) has granted accommodations regarding wearing face coverings, students should contact their instructors to develop appropriate alternatives to class participation and/or activities as needed. Instructors or the student may also contact OARS (336.334.5440) who, in consultation with Student Health services, will review requests for accommodations.













## Course Summary:






Date	Details	Due
Thu Jan 13, 2022	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100135">Week 1 - Thursday Prep: GitHub and VM Setup</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100135">https://uncg.instructure.com/courses/98537/assignments/1100135</a>	due by 10:59am
	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100134">Week 1 - In-class Activities</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100134">https://uncg.instructure.com/courses/98537/assignments/1100134</a>	due by 5pm
Tue Jan 18, 2022	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100139">Week 2 - Tuesday Prep: Read Sections 2.1-2.2 (Background) and Section 14.1 (Security basics)</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100139">https://uncg.instructure.com/courses/98537/assignments/1100139</a>	due by 9:29am
	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100133">Week 1: Assignment</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100133">https://uncg.instructure.com/courses/98537/assignments/1100133</a>	due by 11:59pm

Date	Details	Due
Thu Jan 20, 2022	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100138">Week 2 - Thursday Prep: Practice with the Linux command line</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100138">https://uncg.instructure.com/courses/98537/assignments/1100138</a>	due by 9:29am
	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100137">Week 2 - In-class Activities</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100137">https://uncg.instructure.com/courses/98537/assignments/1100137</a>	due by 11pm
Tue Jan 25, 2022	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100143">Week 3 - Tuesday Prep: Read Sections 3.1-3.4</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100143">https://uncg.instructure.com/courses/98537/assignments/1100143</a>	due by 10:59am
	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100136">Week 2: Assignment</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100136">https://uncg.instructure.com/courses/98537/assignments/1100136</a>	due by 11:59pm
Thu Jan 27, 2022	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100142">Week 3 - Thursday Prep: Finish reading Chapter 3 (The C Programming Language)</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100142">https://uncg.instructure.com/courses/98537/assignments/1100142</a>	due by 10:59am
	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100141">Week 3 - In-class Activities</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100141">https://uncg.instructure.com/courses/98537/assignments/1100141</a>	due by 11pm
Tue Feb 1, 2022	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100140">Week 3: Assignment</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100140">https://uncg.instructure.com/courses/98537/assignments/1100140</a>	due by 11:59pm
Thu Feb 3, 2022	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100146">Week 4 - Thursday Prep: Read part of Section 14.2 (Security in C Programs) and Sections 2.3-2.4 (Valgrind and GDB)</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100146">https://uncg.instructure.com/courses/98537/assignments/1100146</a>	due by 10:59am
	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100145">Week 4 - In-class Activities</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100145">https://uncg.instructure.com/courses/98537/assignments/1100145</a>	due by 12:30pm
Tue Feb 8, 2022	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100148">Week 5 - Tuesday Prep: Read Chapter 4 (Processes)</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100148">https://uncg.instructure.com/courses/98537/assignments/1100148</a>	due by 10:59am
	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100144">Week 4: Assignment</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100144">https://uncg.instructure.com/courses/98537/assignments/1100144</a>	due by 11:59pm



Date	Details	Due
Tue Feb 15, 2022	 <a href="#">Week 6 - Tuesday Prep: Review Section 4.3 and Read Chapter 5</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100150">https://uncg.instructure.com/courses/98537/assignments/1100150</a>	due by 10:59am
	 <a href="#">Week 5: Assignment</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100147">https://uncg.instructure.com/courses/98537/assignments/1100147</a>	due by 11:59pm
Tue Feb 22, 2022	 <a href="#">Week 7 - Tuesday Prep: Read Chapter 12 (Filesystems)</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100152">https://uncg.instructure.com/courses/98537/assignments/1100152</a>	due by 1:59pm
	 <a href="#">Week 6: Assignment</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100149">https://uncg.instructure.com/courses/98537/assignments/1100149</a>	due by 11:59pm
Tue Mar 1, 2022	 <a href="#">Midterm Exam</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100116">https://uncg.instructure.com/courses/98537/assignments/1100116</a>	due by 5:05pm
	 <a href="#">Week 7: Assignment</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100151">https://uncg.instructure.com/courses/98537/assignments/1100151</a>	due by 11:59pm
Fri Mar 4, 2022	 <a href="#">Week 8 - Thursday Prep: Read Sections 6</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100153">https://uncg.instructure.com/courses/98537/assignments/1100153</a>	due by 1:59pm
Thu Mar 10, 2022	 <a href="#">Week 9 - Thursday Prep: Read Sections 7.1- 7.3</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100155">https://uncg.instructure.com/courses/98537/assignments/1100155</a>	due by 10:59am
Tue Mar 15, 2022	 <a href="#">Week 9: Assignment</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100154">https://uncg.instructure.com/courses/98537/assignments/1100154</a>	due by 11:59pm
Thu Mar 17, 2022	 <a href="#">Week 10 - Thursday Prep: Read Sections 9.3-9.6</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100122">https://uncg.instructure.com/courses/98537/assignments/1100122</a>	due by 9:30am
Tue Mar 22, 2022	 <a href="#">Week 11 - Tuesday Prep: Read Sections 11.1-11.4</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100126">https://uncg.instructure.com/courses/98537/assignments/1100126</a>	due by 9:30am
	 <a href="#">Week 10: Assignment</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100121">https://uncg.instructure.com/courses/98537/assignments/1100121</a>	due by 11:59pm

Date	Details	Due
Thu Mar 24, 2022	 <a href="#">Week 11 - Thursday Prep: Finish Reading Chapter 11</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100125">https://uncg.instructure.com/courses/98537/assignments/1100125</a>	due by 9:29am
	 <a href="#">Major Assignment - Part 1</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100118">https://uncg.instructure.com/courses/98537/assignments/1100118</a>	due by 11:59pm
Tue Mar 29, 2022	 <a href="#">Week 12 - Tuesday Prep: Read Sections 13.1-13.3</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100129">https://uncg.instructure.com/courses/98537/assignments/1100129</a>	due by 9:29am
	 <a href="#">Week 11 Assignment</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100124">https://uncg.instructure.com/courses/98537/assignments/1100124</a>	due by 11:59pm
Thu Mar 31, 2022	 <a href="#">Week 12 - Thursday Prep: Finish Chapter 13</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100128">https://uncg.instructure.com/courses/98537/assignments/1100128</a>	due by 9:29am
Tue Apr 5, 2022	 <a href="#">Week 12 Assignment</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100127">https://uncg.instructure.com/courses/98537/assignments/1100127</a>	due by 9:29am
Thu Apr 7, 2022	 <a href="#">Week 13 - Thursday Prep: Read Section 14.3 (Cyber Security)</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100130">https://uncg.instructure.com/courses/98537/assignments/1100130</a>	due by 10:59am
	 <a href="#">Major Assignment - Part 2</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100119">https://uncg.instructure.com/courses/98537/assignments/1100119</a>	due by 11:59pm
Thu Apr 14, 2022	 <a href="#">Week 14 - Thursday Prep: Read MPI materials (link in "prep" page)</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100132">https://uncg.instructure.com/courses/98537/assignments/1100132</a>	due by 9:29am
Tue Apr 19, 2022	 <a href="#">Week 14: Assignment</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100131">https://uncg.instructure.com/courses/98537/assignments/1100131</a>	due by 11:59pm
Wed Apr 27, 2022	 <a href="#">Major Assignment - Part 3</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100120">https://uncg.instructure.com/courses/98537/assignments/1100120</a>	due by 11:59pm
Thu May 5, 2022	 <a href="#">Final Exam</a> <a href="https://uncg.instructure.com/courses/98537/assignments/1100115">https://uncg.instructure.com/courses/98537/assignments/1100115</a>	due by 4:45pm

Date	Details	Due
	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100113">Academic Integrity Agreement</a> ( <a href="https://uncg.instructure.com/courses/98537/assignments/1100113">https://uncg.instructure.com/courses/98537/assignments/1100113</a> )	
	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100114">Academic Integrity Agreement - Final</a> ( <a href="https://uncg.instructure.com/courses/98537/assignments/1100114">https://uncg.instructure.com/courses/98537/assignments/1100114</a> )	
	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100117">Attendance and In-class work</a> ( <a href="https://uncg.instructure.com/courses/98537/assignments/1100117">https://uncg.instructure.com/courses/98537/assignments/1100117</a> )	
	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100123">Week 10 - Tuesday Prep: Read Sections 9.1-9.2</a> ( <a href="https://uncg.instructure.com/courses/98537/assignments/1100123">https://uncg.instructure.com/courses/98537/assignments/1100123</a> )	
	 <a href="https://uncg.instructure.com/courses/98537/assignments/1100156">Week 9 - Tuesday Prep: Finish Chapter 6 and read Sections 7.1-7.3</a> ( <a href="https://uncg.instructure.com/courses/98537/assignments/1100156">https://uncg.instructure.com/courses/98537/assignments/1100156</a> )	