Welcome message

Dear students,

I am glad to see you here and on behalf of Novosibirsk State University and Faculty of computer science, I would like to thank you for choosing our university for your internship. I hope that you will spend fruitful time here and you will enrich not only your technical knowledge but cultural knowledge as well. Here we have theaters, museums, sports grounds, artificial lake (thanks to its size we call it sea), zoo and many other places you will have a chance to visit. You will find some links below.

For all of you, we reserved room #1125. In this room, you will find tables, chairs, desktops, whiteboard. If you don’t have your laptop with you, you can ask Ms. Natalia Pestereva (room #1112/1) to grant you an account on the desktops. Wi-Fi is freely available everywhere in the University (Wi-Fi network - NSU).

Here in the university, we don’t have a strict working schedule. There is no fixed time for arriving and leaving, having lunch or breaks for coffee. From my side, I would like you do not miss or being late on scheduled meetings and you complete everything we, you and me, have planned to do. Taking this into account I would recommend you (not insist) to be at the university from 9:30 to 17:30, Monday to Friday. Saturdays and Sundays are non-working days for you. Use them to learn more about Academgorodok, Novosibirsk, Russian cousin, people, nature, etc. As you have chosen a theme I suggested, I will supervise your work. I plan we will meet at least two times a week (more times if required) to clarify the state of your work and plan your future steps and milestones. Scheduled meetings should not restrict you to wait for the next meeting if you need something to discuss. You can write me an email (arom@ccfit.nsu.ru), drop a message via Skype (arom.skype) or visit my office (room #1122).

Since you are reading this letter, I cannot be with you right now. I am on business trip in the US. I plan to be back in Novosibirsk on May 18th and meet with each of you on Friday 19th. Anyway, I have access to my email and Skype and you are free asking me questions and send requests for additional information. Below, you will find a description of each theme. I ask you to discuss suggested topics with your colleagues and chose the one you liked more. All topics except one (item #8) are for one person. The last item is for two persons. Here they are:

1. “***Implementing and testing algorithm for filtering tidal waves on real data***”.  
   *Mr. Alexandre Tissier wanted to devote his internship to this topic, but I will not restrict him from choosing another one*.  
   We have suggested an algorithm for filtering tidal waves from data recorded by tsunami recorders. Cleared tsunami wave is needed to reconstruct initial sea face displacement at tsunami epicenter and perform direct modeling of tsunami wave propagation. The algorithm we have suggested was developed in Mathcad and then a student performed an attempt to move this algorithm to C/C++ to speed up the code. We would like to move further and suggest:
   1. Implement the algorithm in Python.
   2. Implement a program to retrieve real-time information on the wave profile from open sources
   3. Extract ‘clean’ tsunami wave for future analysis (applying tidal wave filter).
   4. Use cleared signal to reconstruction initial sea face displacement.

This work has both technical and research parts.

1. “***Debugging tsunami wave propagation code***”  
   We use MOST (Method Of Splitting Tsunami) package to perform direct modeling of tsunami wave propagation. This package is widely used over the Word in Tsunami warning centers. We adopted MOST code to NVIDIA GPU a few years ago, but recently we run into the fact that there are some cases where original code works fine, while GPU code becomes unstable and gives tones of NANs as output. We would like you to learn the MOST code (both for CPU and NVIDIA GPU) and understand how to compile, launch and pass parameters. After that, you need to debug GPU code and fix the problem. This topic will give you basic knowledge about tsunami, allow you to learn how to program NVIDIA GPUs, CUDA, approaches to debug programs.
2. “***Adaptation of MOST package on AMD GPU***”  
   If you look at top500.org, you will find that all the powerful computers have hybrid architecture. It gives higher performance and decreases required power. We adopted MOST code to NVIDIA GPU several years ago, and now we would like to have the same code on AMD GPU as well. There are two possibilities to move the code to AMD GPUs: (a) rewrite the code using OpenCL, and (b) using HIP toolkit (HCC platform, hipify tool, and hipcc compiler). I would like to suggest you the following plan:
   1. Learn the MOST code (both for CPU and NVIDIA GPU) and understand how to compile, launch and pass parameters.
   2. Learn OpenCL and HIP approaches. Document general features, pro and cons.
   3. Implement either or both approaches.
   4. Compare performance and accuracy.
3. “***Implementing MacCormack scheme on CPU/GPU***”  
   MOST (Method Of Splitting Tsunami) package is widely used to perform modeling of tsunami wave propagation. The original algorithm was suggested here in Novosibirsk in the middle of 80s and was suited for PCs with limited cache and memory size. The main part of the code is about one hundred lines of FORTRAN code. We have implemented an alternative approach based on MacCormack scheme. We would like you to adopt this scheme to NVIDIA GPU. So, here are the steps:
   1. Learn MOST code and understand how to pass parameters and launch.
   2. Understand MacCormack scheme, boundary conditions.
   3. Compare results MacCormack scheme with what original MOST produce on synthetic and ‘real’ data. We have MacCormack scheme implemented on FPGA, so one can compare with this implementation as well.
   4. Introduce MacCormack scheme into the MOST package. Preferable to have the possibility to switch between two schemes.
   5. Move the code to NVIDIA GPU (either CUDA or OpenACC). Compare accuracy and performance.
4. “***Verification algorithm of reconstruction of initial sea face displacement at tsunami epicenter on real data***”  
   To perform modeling of tsunami wave propagation, we need to know initial sea face displacement at tsunami epicenter. Unfortunately, this information is not available along with earthquake magnitude. One need to use indirect information such as tsunami wave profile recorded by deep water pressure recorders like DART stations. Some time ago we suggested fast algorithm which is based on a theorem from Fourier analysis. We tested the algorithm on synthetic data and we want you to test the algorithm on real historical data. To do this you need to retrieve tsunami wave profile from NOAA DART web site, filter tidal wave, create/obtain a database of wave profiles from unit-sources, apply our algorithm, reconstruct 3D shape, perform direct modelling of tsunami wave propagation and compare obtained marigrams with what you retrieved from NOAA web site.
5. “***Association dictionary. Add new analytic functionality***”  
   Association dictionary project was started in 2012 and is still active. Originally it was developed for French language (<http://dictaverf.nsu.ru>), but later developed engine was used for Russian (<http://adictru.nsu.ru>) and Sakha languages as well. Five years ago, we look at this project as a tool which helped us to analyze some data, so our implementation was limited in terms of functionality and future development. Now we see which functionality required and we suggest you implement the following features:
   1. Cloud of words  
      There are several Javascripts which implement this functionality on the client side. You need to analyze those implementations, select more suitable and integrate this functionality into our project. Here you will learn Javascript, AJAX, PHP, PostgreSQL, JSON, etc.
   2. Statistical charts   
      We need several charts to compare respondents from different areas. Once again there are several implementations. You will analyze them, select one, integrate, configure, and test.

Within this topic, you will work with a customer.

1. “***Association dictionary. Modification DB structure to meet new requirements***”  
   Association dictionary project was started in 2012 and is still active. Originally it was developed for French language (<http://dictaverf.nsu.ru>), but later developed engine was used for Russian (<http://adictru.nsu.ru>) and Sakha languages as well. Five years ago, we look at this project as a tool which helped us to analyze some data, so our implementation was limited in terms of functionality and future development. Here are several extensions for DB we want to have:
   1. The database contains information about respondent (age, mother’s tongue, city, etc.), list of stimulus and response. Unfortunately, we don’t know which information about user we would need in future. So, the task is to make this type of information flexible and configurable for each experiment. Therefore, this information must be stored in the database and an interface must provide functionality to use this information for searching and analysis.
   2. Information in the database could be marked somehow. For example, we would like to mark our database and add information about the influence of western culture. This means that we need to add extra table(s) to our database and provide an interface to access the data.

Within this topic, you will analyze database structure, analyze new requirements, modify the database, update interfaces, perform optimization, testing and integration.

1. “***Association dictionary. Alternative implementation. Investigating the possibilities***”  
   Association dictionary project was started in 2012 and is still active. Originally it was developed for French language (<http://dictaverf.nsu.ru>), but later developed engine was used for Russian (<http://adictru.nsu.ru>) and Sakha languages as well. Five years ago, we look at this project as a tool which helped us to analyze some data, so our implementation was limited in terms of functionality and future development. At that time the easiest way to do this was to write several PHP scripts. It’s understandable that adding new functionality, support for different platforms (mobile devices, tablets, etc.), integrating into social networks, etc. run into a huge problem. We suggest you learn current implementation, look at different CMS systems and different platforms in terms of maintainability and future development, analyze them and suggested the most suitable solution. After that, you will migrate current functionality into selected platform and publish updated website.

Along with this document (or here <https://drive.google.com/drive/folders/0BzkTjmXVJhgaRzJkZVZQd1VfcDg?usp=sharing>), you will find directories which contain detailed information, documents I recommended you to read to dive into the topic.

I am also open to discuss any topic not listed here but you are interested in.

**Recommended for reading:**

We host foreign students for several years. Students share their experience and impression on staying here at NSU in interviews. Unfortunately, interviews are in Russian, but you can use Google translate to read it.

* <http://www.nsu.ru/c45aaaae288adaec5ffedd476a86a39e>
* <http://nsu.ru/stajorovki_na_fit>

**Recommended place to visit**:

Opera theater: <http://novat.nsk.ru/en/>

Zoo: <http://www.zoonovosib.ru/?en>

Historical open air museum: <http://museumiaet.ru/istoriko-arxitekturnyj-muzej-pod-otkrytym-nebom/>. Here you can find links to other museums as well

Coordinates:

<https://yandex.ru/maps/65/novosibirsk/?ll=83.094660%2C54.833591&z=19&text=Novosibirsk&sll=37.620393%2C55.740017&sspn=1.540833%2C0.534576&mode=poi&ol=geo&ouri=ymapsbm1%3A%2F%2Fgeo%3Fll%3D82.920%252C55.030%26spn%3D0.409%252C0.399%26text%3D%25D0%25A0%25D0%25BE%25D1%2581%25D1%2581%25D0%25B8%25D1%258F%252C%2520%25D0%259D%25D0%25BE%25D0%25B2%25D0%25BE%25D1%2581%25D0%25B8%25D0%25B1%25D0%25B8%25D1%2580%25D1%2581%25D0%25BA&poi%5Bpoint%5D=83.094677%2C54.833512&poi%5Buri%5D=ymapsbm1%3A%2F%2Forg%3Foid%3D182965744294>

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<https://yandex.ru/maps/65/novosibirsk/?ll=83.105725%2C54.848891&z=19&text=Novosibirsk&sll=37.620393%2C55.740017&sspn=1.540833%2C0.534576&mode=poi&ol=geo&ouri=ymapsbm1%3A%2F%2Fgeo%3Fll%3D82.920%252C55.030%26spn%3D0.409%252C0.399%26text%3D%25D0%25A0%25D0%25BE%25D1%2581%25D1%2581%25D0%25B8%25D1%258F%252C%2520%25D0%259D%25D0%25BE%25D0%25B2%25D0%25BE%25D1%2581%25D0%25B8%25D0%25B1%25D0%25B8%25D1%2580%25D1%2581%25D0%25BA&poi%5Bpoint%5D=83.106007%2C54.849027&poi%5Buri%5D=ymapsbm1%3A%2F%2Forg%3Foid%3D22236281304>

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Pay your attention on trees: <https://yandex.ru/maps/65/novosibirsk/?ll=83.093446%2C54.847010&z=19&text=Novosibirsk&sll=37.620393%2C55.740017&sspn=1.540833%2C0.534576&mode=whatshere&ol=geo&ouri=ymapsbm1%3A%2F%2Fgeo%3Fll%3D82.920%252C55.030%26spn%3D0.409%252C0.399%26text%3D%25D0%25A0%25D0%25BE%25D1%2581%25D1%2581%25D0%25B8%25D1%258F%252C%2520%25D0%259D%25D0%25BE%25D0%25B2%25D0%25BE%25D1%2581%25D0%25B8%25D0%25B1%25D0%25B8%25D1%2580%25D1%2581%25D0%25BA&whatshere%5Bpoint%5D=83.094833%2C54.846532&whatshere%5Bzoom%5D=19>

Look at the hall and windows: <https://yandex.ru/maps/65/novosibirsk/?ll=83.111720%2C54.841519&z=19&text=Novosibirsk&sll=37.620393%2C55.740017&sspn=1.540833%2C0.534576&mode=whatshere&ol=geo&ouri=ymapsbm1%3A%2F%2Fgeo%3Fll%3D82.920%252C55.030%26spn%3D0.409%252C0.399%26text%3D%25D0%25A0%25D0%25BE%25D1%2581%25D1%2581%25D0%25B8%25D1%258F%252C%2520%25D0%259D%25D0%25BE%25D0%25B2%25D0%25BE%25D1%2581%25D0%25B8%25D0%25B1%25D0%25B8%25D1%2580%25D1%2581%25D0%25BA&whatshere%5Bpoint%5D=83.112755%2C54.841359&whatshere%5Bzoom%5D=19>

<https://yandex.ru/maps/65/novosibirsk/?ll=83.117884%2C54.846245&z=18&text=Novosibirsk&sll=37.620393%2C55.740017&sspn=1.540833%2C0.534576&mode=whatshere&ol=geo&ouri=ymapsbm1%3A%2F%2Fgeo%3Fll%3D82.920%252C55.030%26spn%3D0.409%252C0.399%26text%3D%25D0%25A0%25D0%25BE%25D1%2581%25D1%2581%25D0%25B8%25D1%258F%252C%2520%25D0%259D%25D0%25BE%25D0%25B2%25D0%25BE%25D1%2581%25D0%25B8%25D0%25B1%25D0%25B8%25D1%2580%25D1%2581%25D0%25BA&whatshere%5Bpoint%5D=83.118254%2C54.845945&whatshere%5Bzoom%5D=18&l=stv%2Csta>