AGILE GEOSCIENCE

Custom training courses

Creative geocomputing

Agile* 2015

Agile Geoscience Ltd
PO Box 336 Mahone Bay B0J 2E0 Canada
hello@agilegeoscience.com 1-902-980-0130

Custom training courses in creative geocomputing

Did you know you can work with Agile to create the perfect training package for your geoscientists? Choose from a range of modules that help scientists solve real-world, geoscientific problems — using real data, and real workflows. We will help your best scientists explore their data how they want to, create beautiful visualizations of their analyses, and share state-of-the-art workflows with their colleagues.

We have created these modules specifically for subsurface scientists and engineers. We don't use generic exercises. We are not training scientists to be programmers, we are enabling them to explore their data, free from the boundaries of desktop software, and to develop new tools and workflows for your organization.

Why Agile?

Evan and Matt are geoscientists, first and foremost. They consult actively in interpretation, data management, knowledge sharing , and much of their coding supports their consulting work. They have built several scientific web applications, for applications as diverse as seismic modeling, image processing, and text manipulation. They have the same motivation to learn and experiment as the scientists in your organization. They are enough steps further along the path to help bring people along, but not so far along that they can't remember what it was like to learn.

Course format

The course consists of two or three parts, depending on your needs. The introductory Part A takes one day, Part B is the core component and can take 1 or 2 days. There is an option to add Part C, a 1- or 2-day project-based workshop where participants can work with each other and the instructors on problems that are of direct interest to them.

We deliver our content by alternating short tutorials with hands-on programming exercises. Participants work on their laptops or on workstations in a small classroom setting. They receive the entire set of course materials in the form of a digital interactive coding workbook before the course starts, and they will create their own working code by the end.

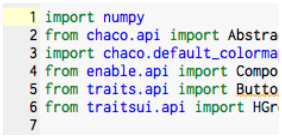
The course uses real industry data such as logs, horizons, and seismic — making it particularly relevant to geoscientists. However, the subject matter we cover is broad enough to be useful to the full range of technical disciplines in the energy and natural resources industry.

We teach using the Python programming language. Python is the fastest growing language for scientific computing because it's easy-to-learn, powerful, and has an ecosystem of thousands of open source code libraries.

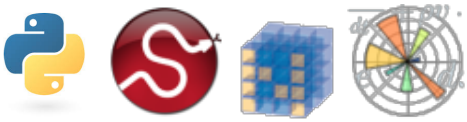
Part A. Fundamentals

Part A lasts one day. We cover the essentials of scientific computing, and the principles of programming. Participants explore the language, learn the syntax, practice writing code, and try different techniques for solving problems. These are the core skills and knowledge required for scientific computing.

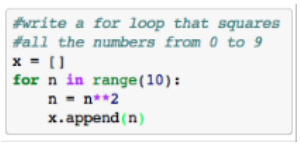
At the end of Part A, participants will have some familiarity with fundamental concepts in computer science, and be ready to tackle some real-world problems on the second day.



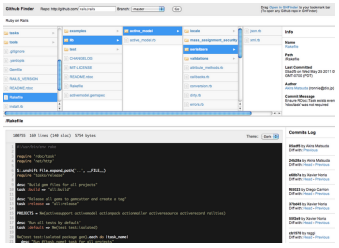
thinking like a computer



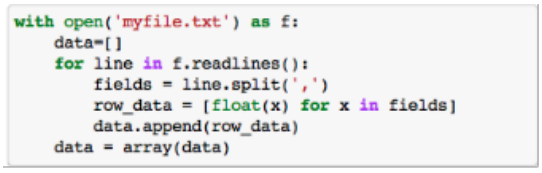
code libraries and APIs



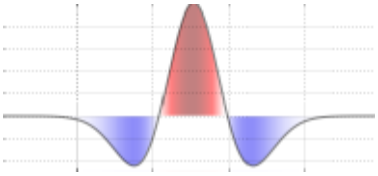
Python syntax



version control



reading & writing data (input and output)



plotting basics

Part B. Problem-solving chapters

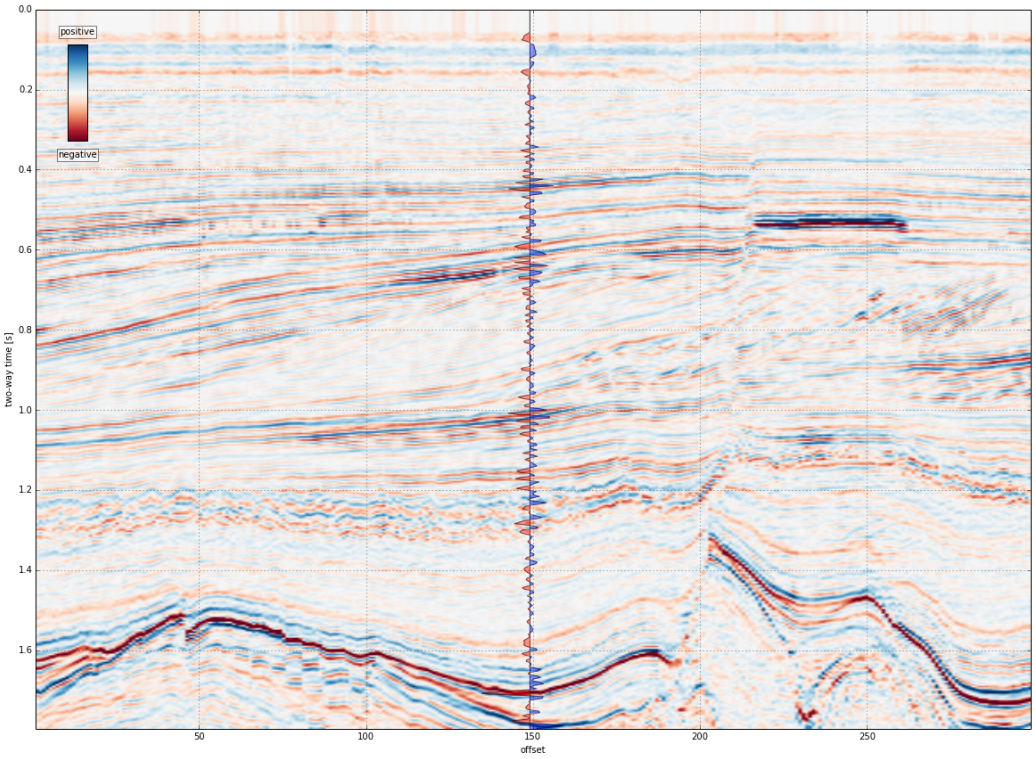
In Part B, participants get to deepen their connection between scientific computing and domain expertise. building on the fundamentals of the first day, Part B is composed of individual *chapters*. Each cover a subsurface theme using real data sets and everyday workflows, from data wrangling to attribute extraction, and from plotting and analysis.

Each chapter takes one day and combines lectures, demos, exercises, and discussion. If you wish, any of them can be customized using your data and your algorithms.

Chapter 1. Seismics and logs are arrays

Scientific computing is largely made up of doing linear algebra on matrices, and then visualizing those matrices for their patterns and signals. It's a fundamental concept, and there are no better examples than seismic and well log data.

This chapter teaches participants how to index and access elements of geoscientific data. Problems involving well logs; a 1-dimensional array of numbers, cross-sections; a 2-dimensional array of numbers, and geologic models; a 3-dimensional array of numbers, can all be addressed with the application of linear algebra, signal processing and visualization. The essential first step in working with data is treating it as arrays.



A conventional 2D section selected from a 3D volume, using the F3 seismic volume, offshore Netherlands (CC-BY-SA by dGB Earth Sciences). We have highlighted a single trace as a wiggle plot. The entire display is using native Python plotting tools and is completely customizable.

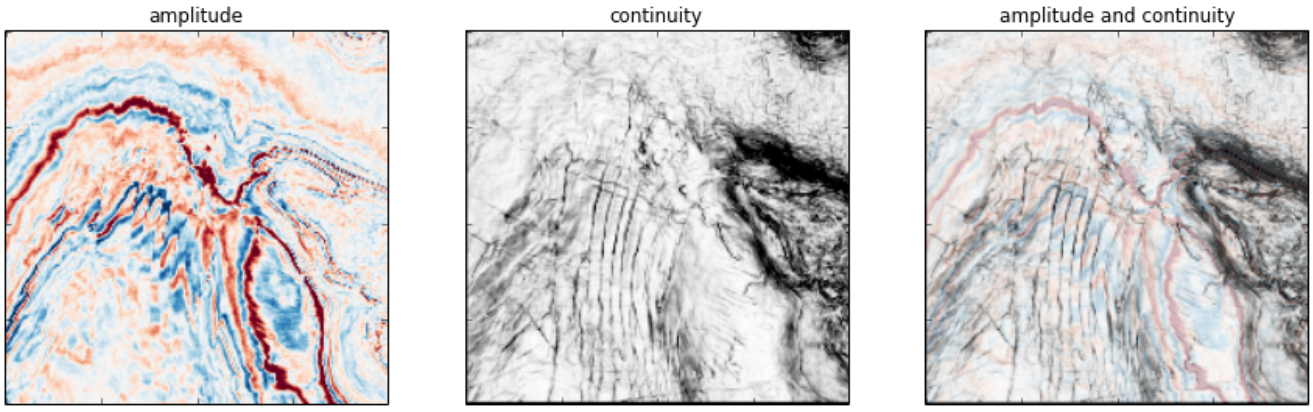
Chapter 2. Seismic attributes you can make

Once a geoscientist understands the notion that digital data are arrays, they may then manipulate these arrays to create their own seismic attributes. In this chapter, we cover horizon attributes, complex trace attributes, and trace-to-trace attributes.

Horizon attributes can be as simple as extracting amplitude from a 3D volume, or as involved as computing curvature at multiple length scales. We look at smoothing surfaces, amplitude extraction, and edge detection.

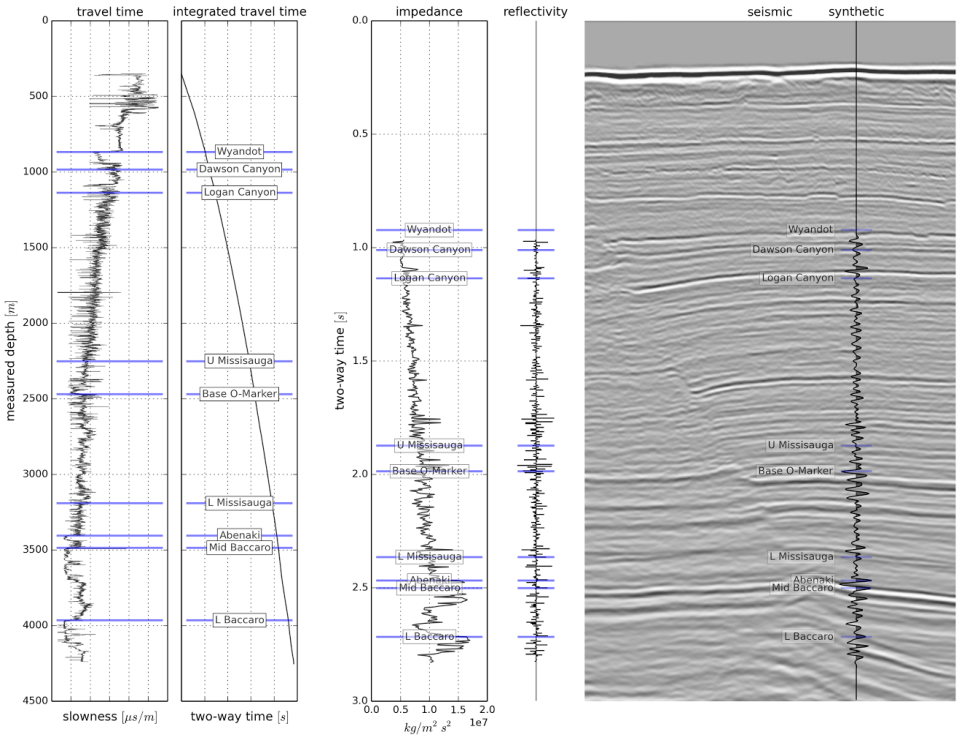
Attributes that are calculated over the entire length of a seismic trace are called complex trace attributes, as described by Taner et al. (1979, *Geophysics* 44). They are fast and easy to calculate and don't require the geoscientist to choose additional input parameters.

Trace-to-trace or multi-trace attributes can be subdivided into calculations of discontinuity (a kind of edge detection) and reflector dip estimation. In this tutorial, participants will write a program using Barnes' (2007, *Geophysics* 72) weighted correlation algorithm to create a *continuity* attribute over an entire 3D volume.



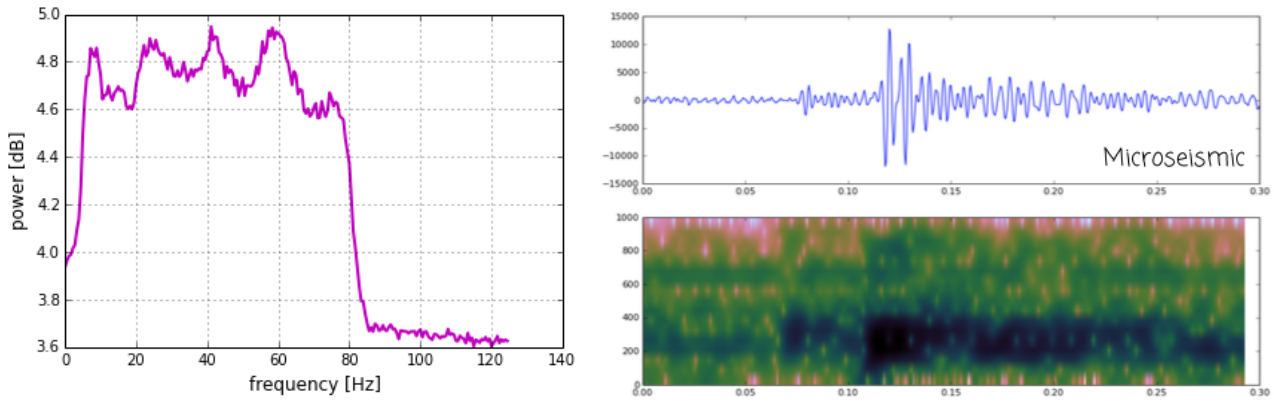
Chapter 3. The calculus of well ties

Well ties are one of the most involved tasks in the seismic interpreter's workflow. The method used for tying a well is subject to the data at hand, and often the software you have available. In this chapter, we use NumPy to compute derivatives and anti-derivatives of a sonic log to study the relationship between travel time, reflectivity, and generating a synthetic seismogram. We cover loading data, dictionaries, mathematical operations, and creating reproducible figures with code.



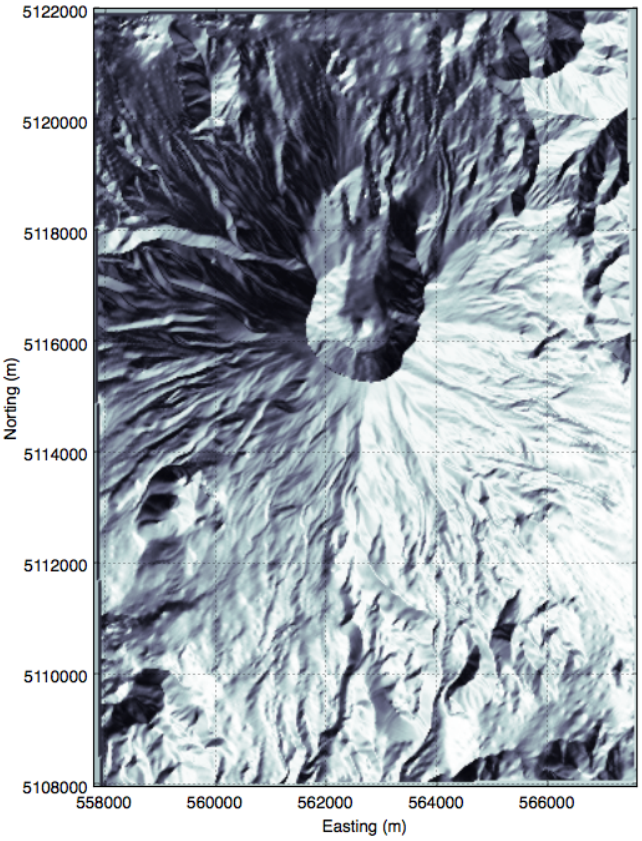
Chapter 4. Seismic data processing algorithms and time-frequency analysis

Time–frequency analysis is at the heart of most of seismic processing and analysis, yet few geoscientists have the tools to really explore how it works. We provide an overview of the time, frequency, space and wavenumber domains, and an introduction to the Fast Fourier Transform and the concept of wavelet transforms. Students can explore seismic and other signals, and build interactive tools to help analyse and improve seismic data.



Chapter 5. Mapping and geospatial tools

Geoscience data belongs in a geographic information system (GIS). In this Chapter we make use of a variety of Python libraries to do powerful things with geospatial data. We start by writing a program to extract a digital elevation model of the Mount St. Helens Volcano from the US Geological Survey website, and explore this data interactively using statistical and graphical methods in Python. Next, we build a 3D seismic survey pattern and compute offset and azimuth distribution in each bin. We then transform these numerical results into Shapefile layers to make them compatible with standard GIS applications such as ArcGIS™ and Google Earth™.



Mount St Helens shaded topography

Computing minimum offset at bin centres

Part C. Project-based workshop

In Part C, which is optional, students will arrive with ideas for projects, then the group will brainstorm and choose projects to work on individually or in pairs, using the instructors as mentors. We will follow the model established in previous classes and at Agile's hackathon events.

The geophysics hackathon in Houston, September 2013. Agile has since organized two geocomputing events for the geoscience community. Participants collaborate on workflow and tool ideas, then create prototypes together. Read more about this event at ageo.co/geophysicshackathon.

Another way to offer Part C is to let the fundamentals sink in for a few weeks, then to follow up later with a refresher and workshop. This way, students can explore on their own, build up questions and ideas, then return with new energy to make progress and implement the skills they have learned.

Supercharge the workshop by inviting others from around the organization to act as mentors for the projects — you will be amazed what people can create together in a short time.

Options

Now you know about the components, you can think about how your organization can best benefit from them. What combination of modules is right for your geoscientists and engineers?

To get you started, here are some ideas:

Building a foundation

- Three-day course.
- We cover Part A and your choice of 2 chapters from Part B.

Exploring data

- Five-day course.
- We cover Part A and your choice of 3 chapters from Part B.
- On the fifth day we cover Part C, the workshop.

Creating tools

- Seven days: a four-day course plus a follow-up workshop.
- First component: four-day course covering Part A and 3 chapters from Part B.
- Second component: 3 months later — 1 day of refresher training and two days in Part C, a problem-solving workshop

Pricing

We believe in pricing transparency and accountability, and are committed to delivering real value. Please talk to us if you have any questions at all.

Our fee depends on the course length and the amount of customization with your own datasets and algorithms. Assuming we deliver our material as-is, the base price for all courses is USD500 per student per day, with a minimum of 4 students.

Due to the interactive nature of this training, we use one technical instructor per 6 students. Additional instructor time will be charged at USD2000/day.

Outside the Europe and the US & Canada, there is a 25% surcharge to cover our increased administrative costs.

Our fees include perpetual licenses for all of our course materials, which includes a substantial amount of working code. They do not include travel expenses, travel time (1 day of instructor time per part of 24 hours), or applicable sales taxes (in Canada).

Committing to multiple runnings of the course will qualify for a volume discount; please talk to us.

For more information contact Matt and Evan at
hello@agilegeoscience.com — 1-902-980-0130