

### Growing the computing capability of researchers to ensure New Zealand's future prosperity

## **Researchers' Digital Literacy**

In a globally competitive research environment, computing capability is one of the important keys to success and New Zealand research institutions must support researchers to develop necessary skills in research computing.

# One of NeSI's key objectives is to grow advanced skills that can apply high-tech capabilities to challenging research questions.

This document outlines how we provide development opportunities to researchers so that they can learn basic-to-advanced research computing skills.

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### **Understanding the Need**

Computation is becoming more than an adjunct supporter of scientific research. Computational principles and tools are integrated into science, changing the fundamental way that science is practiced.<sup>1</sup> Digital capability is an essential skill a researcher needs to acquire to stay competitive.

At present New Zealand researchers have varying levels of understanding or expertise or awareness of the digital capabilities at their disposal. Many researchers self-teach the relevant skills, which may not be the best practice, or the best utilization of available resources. Many research teams rely on a few talented researchers with the necessary computing skills, but they may risk losing critical capabilities when the skilled researcher leaves the team.

In supporting researchers to develop necessary skills to utilize digital platforms and services, it is important for New Zealand research institutions to acknowledge the following principles.

Exposure to new workflows	Augmenting outcomes and increasing efficiencies by adopting digital research methods.
<b>Recognition of dependencies</b>	Collaborating with technologists and researchers for specialised training as mentors and subject matter experts.
Promotion of successes	Celebrating through storytelling to reinforce skills transfer, and foster interactions across research communities.

Researchers are the guardians of values associated with ethical research conduct, and assume individual and collective responsibility to find and utilise efficient and effective methods to meet their research needs.

<sup>&</sup>lt;sup>1</sup> "Towards 2020 Science - Microsoft Research." 2008. 23 Nov. 2015 <u>http://research.microsoft.com/en-us/um/cambridge/projects/towards2020science/downloads/</u> <u>T2020S\_ReportA4.pdf</u>

#### **NeSI Values**

NeSI enables researchers as they contribute within the New Zealand research sector, supporting sector growth and evolution. NeSI's contributions are rooted in the following values.

NeSI cooperates with researchers by providing superior computer **Supportive** power, support systems and training to underpin the integrity of their research. Pathfinding NeSI leads the way in formulating innovative future strategies, and achieving better alignment of institutions and methodologies (data, standards, tools and investments). NeSI is an active and influential voice for positive change. Collaborative NeSI brokers deeper collaborative ties at both management and operational levels between institutions, researchers and government. Understandable NeSI makes sense of science by clearly articulating its objectives, activities and research project outcomes in ways that can be more easily understood by a wider audience.

## **Table of Contents**

Understanding the Need NeSI Values Positioning Promoting models for training delivery Strategic Roadmap Basic skills - since 2014 Train the trainer - from early 2016 Training in methods - from 2017/18, adapting to opportunities NeSI's training offerings Glossary

### Positioning

NeSI provides high performance computing infrastructure and support to enable New Zealand's researchers to tackle the world's largest problems. While training is only one of many offerings from NeSI to the research community, it is an effective way to build and grow NeSI user community, accelerate knowledge transfer and enhance research capability in the sector. This provides a foundation for NeSI to be successful in its mission of delivering HPC service and support to the research community. Through various workshops and other programs in the past, NeSI has identified our objectives from the training programme. We see our training programme from the following two perspectives.

A NeSI-centered view of training enables us to build working relationships with New Zealand research communities over time. We establish training as a programme, looking beyond one-time events or engagement, viewing our activities as connecting an ecosystem of offerings and stakeholders to realize their potential. This helps us build a network of knowledge, skills and behaviours across New Zealand.

A learner-centered view enables us to create empathy for the journey a researcher takes, aligning NeSI with a researcher's own view of their development. We are able to capture their impressions, their feedback, and we gain an understanding of our services from their perspective which is outcome-oriented.

NeSI continually revises our specialist training offerings to deliver more useful and relevant training programmes to New Zealand research community. Some of our training programmes will be offered in partnership with other institutions, and NeSI aims to be viewed as a trusted partner by public and private research groups to be successful in the collaboration.

To maintain and improve the quality of our training offerings, in a separate document "NeSI training playbook", we outline how we evaluate our services through an industry-standard approach.

#### Promoting models for training delivery

Since 2014, NeSI staff have run a series of workshops to up-skill researchers in digital research tools and methods. NeSI's leadership of such programmes is in place until enough local expertise and momentum are sustained. NeSI enables access to high quality training programs, such as Software Carpentry, and we highlight ways to foster researcher communities of practice (such as Hacky Hours). NeSI's next efforts aim at building partnerships with well-rounded, deeply committed researchers with desire and ability to lead skills transfer within their communities (a train-the-trainer approach).

## Strategic Roadmap

NeSI's Researcher Digital capability development plans see us move through three overlapping phases over the coming years, as our confidence grows and the sector takes ownership of sustaining training capabilities.

We build digital research methods training capabilities within partnerships to sustain research digital literarcy	Training in advanced skills in applications and methods.
	Train the trainer to grow sector ability to scale training
	Training in basic skills to use tools, platforms, and services
	We grow researcher digital literacy capacity within the research sector, over time



These phases provide a primary focus, and allow us scope to adapt to sector needs as we witness anticipated shifts in researcher and research sector capabilities. We will execute them in stages, with the activities from earlier phases continuing as BAU activities.

Phase	Status	Goals	Evaluation Target
<b>Basic skills</b> as primary focus	Running 2014 >	Build our confidence in our reflective training practice Inform our strategy through engaging with researchers, their institutions and communities	2 new Software Carpentry instructors 6 experienced Software Carpentry helpers 6 Software Carpentry workshops 2 HPC-specific workshops
Train the trainer as primary focus	Planning 2016 >	Share our practices as instructors, enabling institutions and communities to assume a lead role Build partnerships to sustain capabilities over time	5 new Software Carpentry instructors 15 experienced Software Carpentry helpers 2 Research Bazaar events 6 Software Carpentry workshops led by NeSI 6 training events led by community <sup>2</sup> 4 HPC-specific workshops

 $<sup>^{\</sup>rm 2}\,$  May include Software Carpentry and/or other events that the community wants (eg. Hacky Hours)

			3 Scientific Computing Clinics
Training in methods as primary focus	Planning 2017 >	Research applications and methods training supports researchers with world class digital literacies to approach challenging research problems	30 new Software Carpentry trainers 4 ResBaz events ? Software Carpentry workshops ? HPC-specific workshops ? world-class science output TBC - More targets to be added

These training capabilities can be best sustained longer term if basic research computing is introduced as a part of education programmes in universities - It will be of NeSI's best interests to engage with universities as such opportunities arise.

#### Basic skills - since 2014

NeSI takes an active role in leading and organising events, collaborating with local research communities and institutional hosts, building capacity and community using Software Carpentry and other approaches.

NeSI's instructors offer the following supports:

- A. The creation of common shared experiences.
- B. Demonstration of best practices, sharing of explicit documentation, and development and deployment of a common core of evaluation approaches.
  - Repeatable and scalable processes,
  - Procedures, measures and specific staff assigned responsibilities to provide and measure existing training,
  - A team that carries out their training work *but understands the need for a new culture* across researchers and their communities.

#### Train the trainer - from early 2016

NeSI adds train the trainer activities into the programme, enabling others to take a lead, to grow the scale of training activity across the sector. This adds risks which are best mitigated by a focus on quality control.

This partnership with community is expected to offload NeSI's commitment for entry-level training, alleviating resources allocation difficulties and affords NeSI to shift gradually to intermediate/advanced levels of methods-aware training.

At the beginning, there will be a normalization process (and iterative experimentation), while the expectation is of a growing number of local community-led training events with NeSI's initial help through mentorship, sponsorship and support.

NeSI also starts to introduce and pilot training in advanced skills in applications and methods.

#### Training in methods - from 2017/18, adapting to opportunities

By 2017, NeSI will have seen:

- Researcher communities capable of self-servicing basic research computing needs through nation-wide community-led training activities,
- some universities providing basic research computing training programmes as a part of standard postgraduate coursework,
- growing evidence of research computing capabilities within research communities.

Leveraging successes from earlier work, NeSI shifts to provision of advanced, methods-aware training. Such training might be provided by NeSI team members or through partnership with others, including methods experts within the research community, or vendors of specialised software packages and platforms.

Existing training activities continue as BAU.

This phase has the highest risk profile - each training offering will depend on specialised expertise and will require significant resources allocated to preparation, coordination and delivery. It is anticipated that such training is done in close partnership with known research communities, whereby the capabilities supported are identified in that communities long term research plans. Successful execution will enable world class research outputs produced by researchers trained and supported by leading experts in appropriate digital research methods.

#### **NeSI's training offerings**

Training is an investment - We do not want our training to be limited to knowledge transfer. We want the participants to change their behaviour and apply new knowledge to their workflows to improve research productivity. Motivation is the key that leads to goal-directed behaviour, and it is important to understand the participants' (1) subjective value of a goal and (2) expectancies (expectations for successful attainment of that goal)<sup>3</sup>. In other words, the training will be more motivational if it is more *relevant* to their goal and the participants *trust* the expected outcome it promises. The Communicator's Roadmap model<sup>4</sup> captures this concept well. This model measures content on the horizontal axis (ie. relevance), and emotional connection on the vertical axis (ie. trust).

We present NeSI's current or upcoming training offerings following this model, and we intend to develop and evolve them to be more audience-centered and more emotionally engaging with the research community.



<sup>&</sup>lt;sup>3</sup> Ambrose, Susan A. et al. *How learning works: Seven research-based principles for smart teaching*. John Wiley & Sons, 2010.

<sup>&</sup>lt;sup>4</sup> "How to Get Employees Excited to Do Their Work." 2015. 23 Nov. 2015 https://hbr.org/2015/05/how-to-get-employees-excited-to-do-their-work

- **Software Carpentry** An international initiative helping researchers to increase research productivity by acquiring basic research computing skills. Usually 3~4 segments delivered in two full days. NeSI maintains at least 2 certified instructors, and is an affiliate of the Software Carpentry Foundation.
- Partnerships &NeSI provides a customized training workshops in collaboration withco-hostingpartner institutions and research communities.
- HPC CoursesNeSI partners within educational programmes to deliver HPC courses.<br/>Working with NeSI's team, University of Canterbury HPC Centre has<br/>delivered 3 HPC courses a year since 2007, covering Parallel<br/>Computing Architectures, Parallel Programming using the Message<br/>Passing Interface, and Structured Programming for Scientific<br/>Computing.
- HPC Workshops High Performance Computing is NeSI's core expertise area and NeSI has developed and delivered a number of HPC specific workshops NeSI induction training, specialised software tools and platforms workshops, research methods workshops, HPC software development workshops including debugging and profiling techniques.
- Train the trainerNeSI maintains experienced and where appropriate certifiedinstructors who can train the trainer, to grow our capacity to train.
- **Vendor Workshops** NeSI works with external trainers from vendors of highly specialised hardware or software products. (eg. NVidia GPU, Intel Phi, OpenFOAM, etc.)
- Research BazaarA three-day conference/workshop aimed at helping researchers with<br/>their research computing needs through community building<br/>activities and workshop sessions. Key topics areas include data<br/>analysis, visualisation, software development practices and tools,<br/>computer aided design and digital humanities.

Hacky Hours	An informal social gathering to discuss and work on participants recently/currently experienced challenges and breakthroughs related to "code, data and digital tools". University of Auckland Centre for eResearch hosts this on regular basis. http://uoa-eresearch.github.io/HackyHour/
Research Computing Clinic	NeSI collects researchers' questions regarding their research computing problems before an event, selects one and presents how we solve such a problem.
Glossary	
Digital Literacy	The knowledge, skills and behaviours applied to broad range of digital equipment and services such as the use of the HPC and its applications.
Training	<ul> <li>We provide hands-on coaching designed to have measurable impact of scientific activities of New Zealand public and private organizations.</li> <li>Will be defined as "the Acquisition of knowledge". ☑</li> <li>It applies in the first two moments of learning need:</li> <li>I. Learning for the first time (informational function).</li> <li>II. Expanding upon what was learned ☑ (directed learning).</li> </ul>
Performance Support	Will be defined as "the Application of knowledge". It applies in the last two moments of learning need: III. Remember or act upon what was learned (apply). IV. Solve problems or fix things that break (solve).
Research Institutions	Universities (through Universities NZ); CRIs (through Science NZ); IROs (through IRANZ); National Grand Challenges; Centres of Research Excellence.
CRI	Crown Research Institution
Researchers	Individuals who are students, academics or full-time workers at CRIs.