Where Next?
Some Musing on the Future of Software Architecture

Ian Gorton
R&D Lead, Data Intensive Computing
Pacific Northwest National Lab
Lots has been achieved

- 20+ years has seen great advancements in software architecture:
  - Methods
  - Processes
  - Design tools/modeling
  - Frameworks
  - Best practices/patterns
  - Standards
But are we running out of steam?

• Many incremental improvements over last 5 years
• Any really exciting innovations in our field:
  – In research?
  – In practice?
• Are these addressing the growing complexity and scale of systems?
  – Hmmmm...
Becoming Quantitative ...

• Qualitative = ‘touchy feely’
• Need quantitative methods/tools for architecture analysis and design, e.g.
  – Assessing design alternatives
  – Buy versus Build
  – Cost/effort estimate predictions from architecture models
  – Performance/scalability predictions from architecture models
• Many numerical methods exist that could be exploited:
  – Uncertainty quantification
  – Sensitivity analysis
  – Decision theory (e.g. AHP)
  – Regression
  – Error analysis
But isn’t Quantification hard?

• Yup - but it doesn’t stop others ...
• Climate models
  – Simulations typically ‘calibrated’ to produce outputs that match reality (ie historical data)
  – They ‘adjust’ for ‘bias’ in models
  – Much still unknown about the physics/chemistry of climate at a global scale
• We need concerted R&D to move software architecture to more quantitative foundations
  – Models
  – Methods
  – Tools

```plaintext
; Apply a VERY ARTIFICAL correction for decline!
; yrloc=[1400,findgen(19)*5.+1904]
valadj=[0.,0.,0.,0.,0.,-0.1,-0.25,-0.3,0.,-0.1,0.3,0.8,1.2,1.7,2.5,2.6,2.6,2.6,2.6,2.6,2.6]*0.75 ; fudge factor
if n_elements(yrloc) ne n_elements(valadj) then message,'Oooops!'
yearlyadj=interpol(valadj,yrloc,timey)
```
And we need to Study Scale (Ultra Large Systems)

- Size of systems is growing rapidly, e.g:
  - Smart grid
  - Internet-scale applications
  - Scientific data repositories
  - Internet of Things/Sensor networks
- Scaling stresses everything
  - Design, Development
  - Deployment, Evolution
- Building Internet Scale systems remains very much a ‘black art’
  - Something the software architecture community is well positioned to address?
  - Approaches must combine both design and technology, reaching down the various technology stacks
  - [http://highscalability.com/](http://highscalability.com/) is a great read

“Twitter alone generates more than 7 terabytes of data every day, Facebook 10 TB...”
Summary ...