What training challenges do we face?

We know how to train astrophysicists who can succeed in today’s environment but what about in the era of GAIA/LSST/Euclid etc

What are some of the new skills required for the next generation

- Data Wrangling: processing, visualization, cross matching
- Data Analytics: statistics, machine learning, uncertainty
- Data Modeling: parametric/non-parametric non-Gaussian
- Collaborative Science: software engineering (design, github, unit tests, code reviews), provenance, workflows

How can we fit this in our current (over scheduled) curricula
What can we use (or who can we learn from)?

**Bootcamps:** short courses (e.g. software carpentry) to get people started, MOOCs for on-line learning

**Student cohorts:** series of coherent workshops (e.g. GAIA GREAT networks) with computational and astrophysics components

**Cross-disciplinary cohorts:** IGERT programs in US for interdisciplinary graduate student programs

**Many initiatives and opportunities** in data science education that we could build from (mainly privately funded)

Question remains: how do I reach level 9 if I am only taught intro level
Improving Science Potential
The Gaia/GREAT Example

Gaia Research for European Astronomy Training (GREAT) co-Chairs

GREAT-ESF: http://www.great-esf.eu
GREAT-ITN: http://www.great-itn.eu
GREAT-ESF Research Network

~1200+ scientists attending ~30+ events

http://great.ast.cam.ac.uk/Greatwiki/GaiaScienceMeetings

See this link also for the final reports from each meeting

GREAT ESF supports science exchanges and meetings
Many papers, proceedings, white papers, proposals generated

GREAT-ESF Workshop Gaia and Exoplanets: GREAT Synergies on the Horizon, 5-7 Nov 2012, Torino, Italy (workshop website)
GREAT-ITN School Galaxy modelling, 15-20 Oct 2012, Besancon, France (school website)
GREAT-ESF Workshop Asteroseismology with large time-resolved astronomical surveys, 19-21 Sep 2012, Institute of Astronomy, University of Leuven, Belgium (workshop website) (Meeting Final Report)
GREAT-ESF Workshop Stellar analyses in the Gaia-ESO Survey: towards the first Data Release, 19-21 Sep 2012, AIP, Potsdam, Germany (workshop website) (Meeting Final Report)
GREAT-ESF Workshop Gaia-Follow up Network-Solar System Objects 2012, 19-21 Sep 2012, Observatoire de Paris, France (workshop website)
GREAT-ESF Workshop 3rd Gaia Science Alerts Workshop, 6-7 Sep 2012, Bologna, Italy (workshop website) (Meeting Final Report)
GREAT-ITN/GREAT-ESF School The Art of Observational Campaigns, 3-7 Sep 2012, La Laguna, Tenerife, Spain (school website) (Final Report)
GREAT @ The IAU General Assembly, 27 - 31 Aug 2012, Beijing, China (Assembly website) (wiki site)
GREAT PLENARY 5th Great Plenary Meeting, 4 - 6 Jul 2012, Rome, Italy (Plenary website) (wiki site)
  - The GREAT Plenary will be taking place at the European Week of Astronomy, as Special Meeting 2 (4 Jul) and Symposium 5 (5 Jul)
GREAT-ITN School International School of Astrophysics: Distances and Supernovae, 11 - 15 Jun 2012, Teramo, Italy (school website) (Final Report)
GREAT-ESF Workshop The metallicity distribution in the Milky Way discs, 29-31 May 2012, Bologna, Italy (workshop website) (Meeting Final Report)
GREAT-ESF Workshop Stars without borders, radial migration in spiral galaxies, 21 - 24 May 2012, Mediana, Slovenia (workshop website) (Meeting Final Report)
GREAT-ESF Survey Workshop : Spectrum Analysis of FGK stars, 18-19 Apr 2012, Observatoire de la Côte d’Azur, N (workshop website) (Meeting Final Report)
GREAT-ESF Workshop Galaxy Modelling with a Gaia mock catalogue, 29 February - 2 March 2012, Universitat de Barcelona, Spain (website) (Meeting Final Report)
GREAT-ITN School Managing Complex Systems, 30 Jan - 3 Feb 2012, ESTEC, ESA, Noordwijk, The Netherlands (school website)

2014

- GREAT-ESF Workshop Gaia Viz Workshop, TBD early 2014, Vienna, Austria

2013

- GREAT-ESF School EES2013 23rd Evry Schatzman School on Stellar Astrophysics Stellar ages, 29 Sep - 4 Oct 2013, Roscoff, France (school website)
- GREAT-ESF Workshop The World of Clusters, 23-26 Sep 2013, Padova, Italy (Workshop website)
- GREAT-ITN/GREAT-ESF School The Galaxy, stellar compositions and dynamics, TBD Sep 2013, Tenerife, Spain
- GREAT-ESF Workshop Gaia Challenge, 19-23 Aug 2013, University of Surrey, UK
- GREAT PLENARY 6th Great Plenary Meeting, 10 - 12 Jul 2013, Turku, Finland (Plenary website) (wiki site)
  - The GREAT Plenary will be taking place at the European Week of Astronomy, as Special Meeting 5 (10 Jul) and Symposium 11 (11-12 Jul 2013)
- GREAT-ESF Workshop Fundamental Stellar Parameters - Special Session 3 @EWS, 6 Jul 2013, Turku, Finland (workshop website)
- GREAT-ITN/GREAT-ESF School GREAT Astro-statistics School, 17-21 Jun 2013, Alicante, Spain (school website)
- GREAT-ESF Workshop Asteroid Spectroscopy in Support of Gaia, 6-7 Jun 2013, Nice, France (workshop website)
- GREAT-ESF CONFERENCE First Results from the Gaia-ESO Survey, 8-11 Apr 2013, OCA, Nice, France (conference website)
Science Theme: Unravelling the Milky Way – from the Galaxy to Asteroids
Increase the European potential in scientifically exploiting Gaia
Develop multi-wavelength, multi-domain techniques incorporating information from Gaia
Transfer best practice in the use of new IT techniques
Trains a cohort of students across Europe ready for Gaia
GAIA-LSST Astro-Visualisation School
13-18 Sept 2012 at the University of Washington, Seattle, USA

This workshop is jointly organised by the Gaia GREAT-ITN and GREAT-ESF networks, University of Washington (representing the LSST Consortium) and Microsoft Research. It is tailored to provide a theoretical exploration of the latest data visualisation techniques, and also hands-on practicals illustrating specific data challenges that will be presented by the upcoming Gaia and future LSST missions and telescopes.

The workshop will be limited to 40 student attendees. The workshop will be of interest to PhD and early stage researchers working with the GREAT-ITN network, the wider Gaia- GREAT community, LSST partners, and others interested in Gaia and/or LSST science challenges.

Organising Committee:
Andrew Connolly (co-Chair, University of Washington, USA)
Nicholas Walton (co-Chair, University of Cambridge, UK)
Jonathan Fox (Microsoft Research, Redmond, USA)

Background image: Seattle Space Needle - SahilChopra (subject to CC licensing)
Leveraging LSST@Europe – next steps

- Training activities: Within Europe / Within USA / Global activities linking continents
- Increasing science capability: now and next
  - Science coordination/ training via the LSST science working groups
- Identifying key cross cutting challenges
  - e.g. big-data analytics
- Key ‘resource’ opportunities
  - USA – via NSF/ private funding etc
  - EU – via Horizon 2020 programme
- Science potential ‘contact’ group
Next Step Actions

- Interest group: ...
- Training/ networking focus areas: ...
- Maintaining momentum: ...
- Milestones: e.g.:
  - next LSST consortium meeting session
  - LSST – Gaia/GREAT community workshop
  - LSST ...