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Analytical platform
Vision of future medicine

Medical treatments (drugs applied to whole organism)

Basic biology (cells, molecules)
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The promise of the Human Genome Sequence
In principle, by modelling

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Dynamic behaviour (cells, whole organisms)

↑ prediction

Molecular interactions

↑ prediction

Molecular structures

↑ prediction

Transcriptome

↑ prediction

Genome
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In reality, data driven

Dynamic behaviour  \[\overrightarrow{\text{prediction}}\]  \[\overrightarrow{\text{Cellular expression etc.}}\]

Molecular interactions  \[\overrightarrow{\text{prediction}}\]  \[\overrightarrow{\text{Two hybrid experiments, etc.}}\]

Molecular structures  \[\overrightarrow{\text{prediction}}\]  \[\overrightarrow{\text{Structural Genomics}}\]

Transcriptome  \[\overrightarrow{\text{prediction}}\]  \[\overrightarrow{\text{EST, cDNA}}\]

Genome  \[\overrightarrow{\text{Multiple genomes}}\]

High throughput data collection on vast scale required
The main objective of the Analytical Platform is to develop detailed analytics’ strategies during the first phase of the ITFoM project which will be used in the main phase of the ITFoM flagship project.

Tasks:
• Discussion of the technology areas, formulation of research and development plans addressing all sub-topics
• Discussion of the interfaces at the partner sites
• Writing the above reports and parts of the publications
• Analytics contributions to the test case scenario ‘sequences to models’
• Analytics contributions to the test case scenario ‘molecules to patients’
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Types of platforms

• Sequence based analysis
• Antibody based analysis
• Mass spec-based proteomics
• Metabolomics
• Imaging
• iPS-omics
• Databases
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10 years after Human Genome Sequence

- GWAS demonstrated that relationships between genes and disease for common diseases could be found
- Appropriate scale of high throughput data collection possible and affordable
- Importance of infrastructures to enable storage and sharing of these huge datasets recognised
High throughput data collection examples

- From genome to populations
  - 1000 genomes project
- From variation to disease
  - International Cancer Genome Consortium
  - uk10K
- From genome to cellular state
  - ENCODE
  - Roadmap epigenetic project
Genomics:
The complete blueprint of an individual. In perspective the time for sequencing the whole genome of an individual is less and less, and the genome of more and more individuals will be available (Kurt Zatloukal, Hans Lehrach).

Proteomics:
About 100 thousand proteins from ~22000 genes. The expression of proteins is tissue/cell dependent. Well being corresponds to the correct amount of proteins in a tissue/cell.

Metabolomics:
Genomics tells you what could happen. Metabolomics of biological fluids and tissues/cells tells you what has happened. The metabolites are only a few thousand.
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Metabolomics

NMR-based metabolomics

Metabolic fingerprint
Part of the $^1$H NMR spectrum of human urine
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Pilot project 180 samples
Extension to 1,170 samples summer 2010
1900 samples early 2011, 2500 samples end 2011

~100 per population: 4x Whole Genome Shotgun + Deep Exomes
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100 trillion cells >200 cell types
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Infrastructure for data

BioMedBridges:
Data bridges between biological and medical infrastructures in Europe (ESFRI)
Examples of scale

- Wellcome Trust Sanger Institute
  - Largest genome sequencing centre in Europe; world’s 3rd largest; output has doubled every 6 months for several years
  - Has already sequenced 100 terabases (1 human genome is 6 gigabases)
- European Bioinformatics Institute
  - Hub for ELIXIR infrastructure
  - Aggressive roadmap to collect and organise global datasets with appropriate data reduction
- Each has ~12 petabytes of storage
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ITFoM brings together resources and expertise

- Data
  - Biological and Medical
- Algorithms
  - World leading pan-European university research base in Computational Sciences, e.g. via PASCAL2
- ICT
  - Research laboratories and development facilities of key world leading multi-national IT companies
The project outcomes will enable the prediction of health, disease, therapy and its effects for individual patients and through application in the clinic will change the future of medicine.

For more information:
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