Bioinformatics – application and potential

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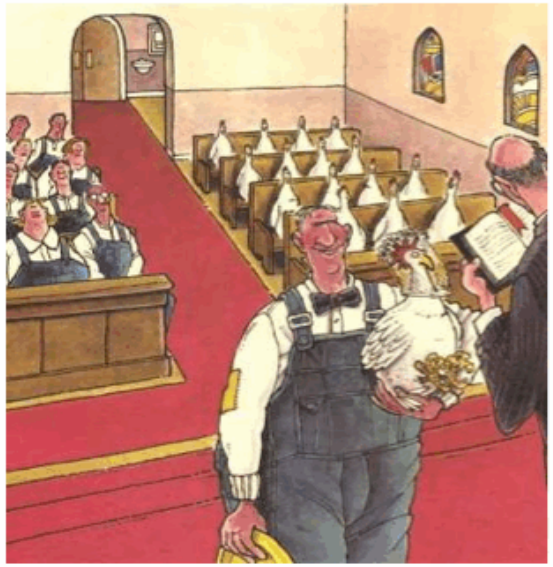
What is Bioinformatics?

BIO + INFORMATICS

Biology

Information Technology/Computers

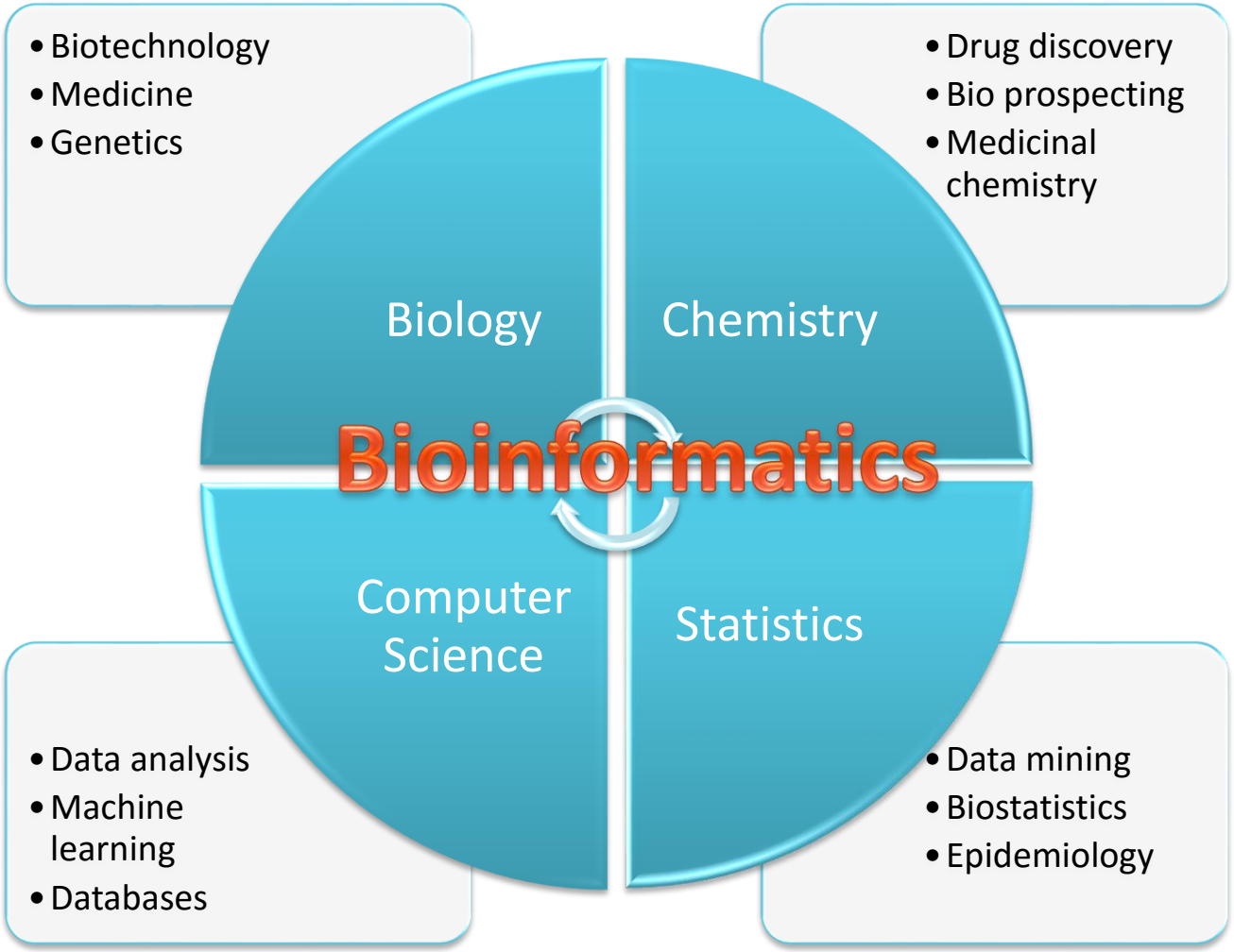
A marriage between Biology and Computers!



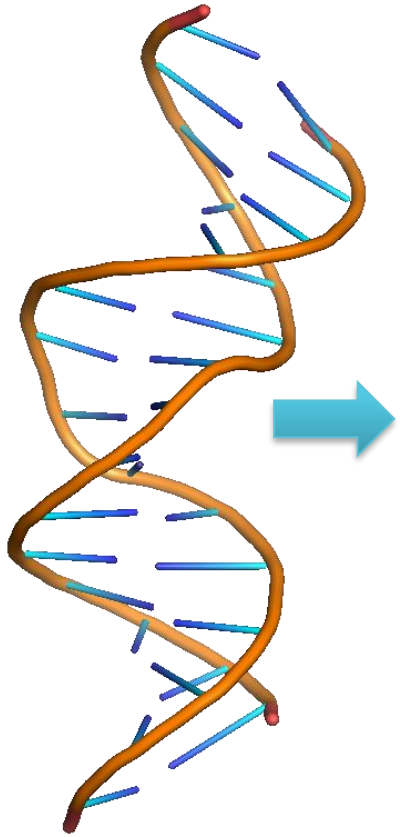
Pic from bioportal.weizmann.ac.il

Bioinformatics is a branch of science that uses computers for storage, retrieval, analysis, visualization and distribution of information related to biological macromolecules like DNA, RNA and Proteins

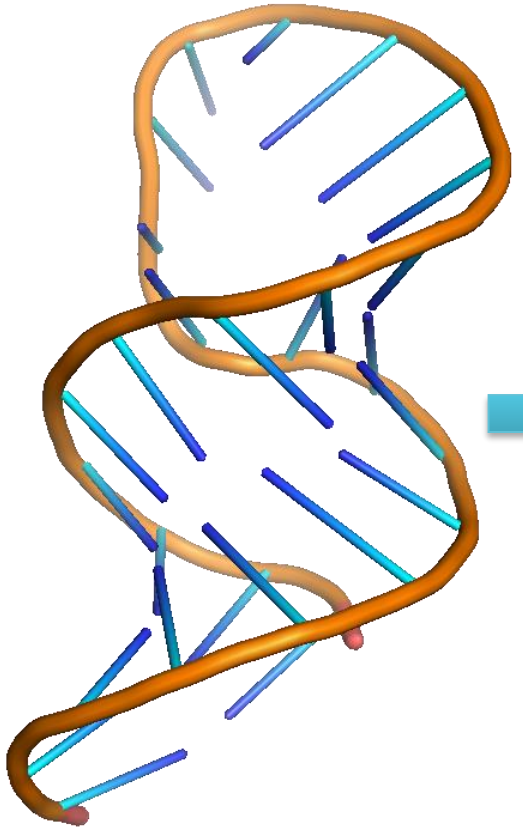
Interdisciplinary Science



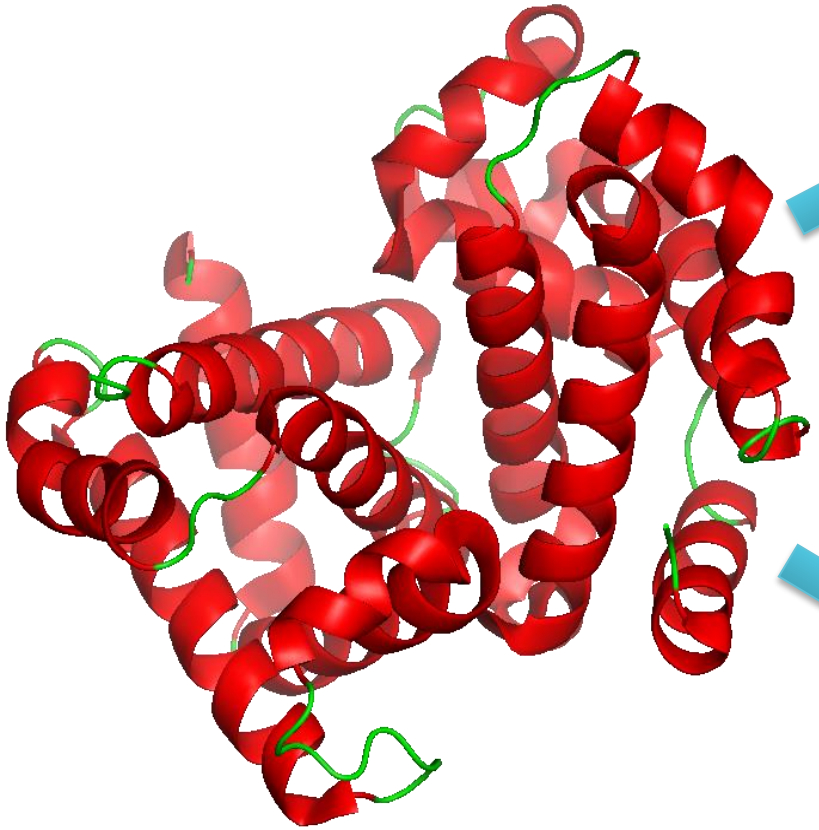
Central Dogma



DNA
Genome



RNA
Trancriptome

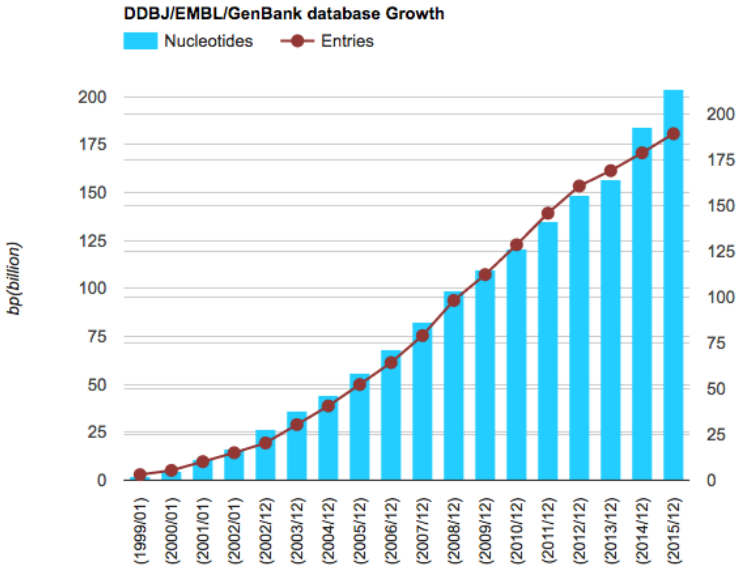


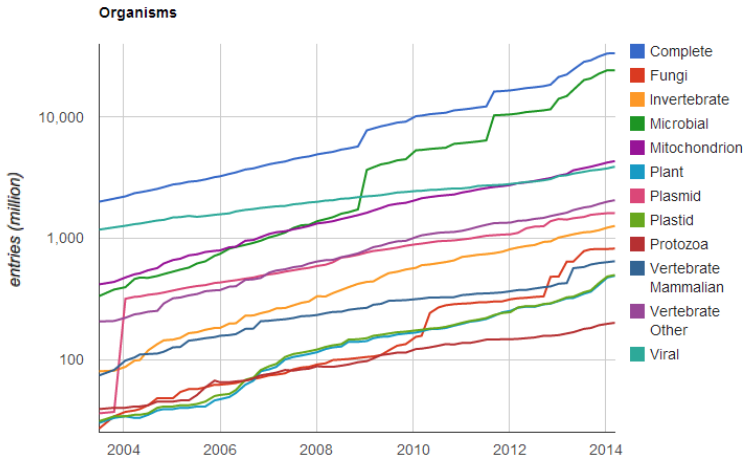
Protein
Proteome

Cellular
Phenotype

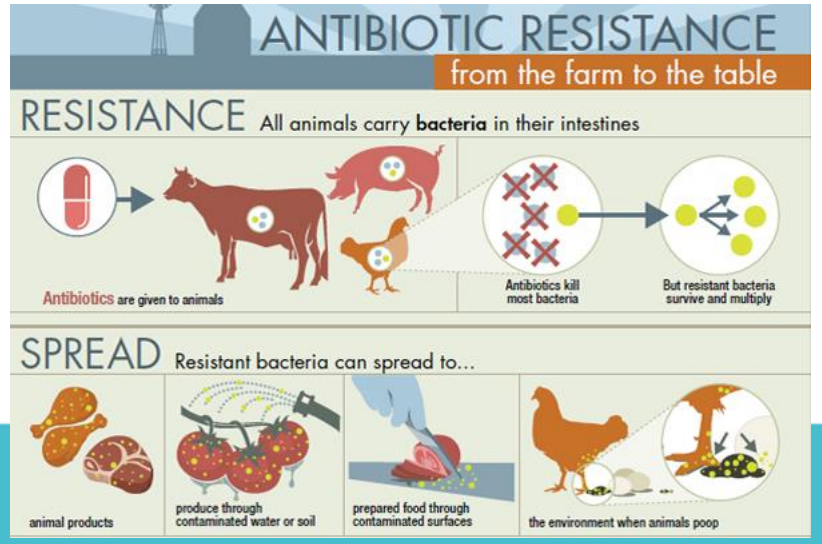
Why is it important?

- Massive quantities of data
  - Genomics
  - Clinical
- Solve important problems
  - Disease diagnosis & cure
  - Crop improvement
  - Antibiotic resistance
  - Alternative energy source
- Success is rewarded
  - Financial gains
  - Patents/Publications
- Need for efficient solutions



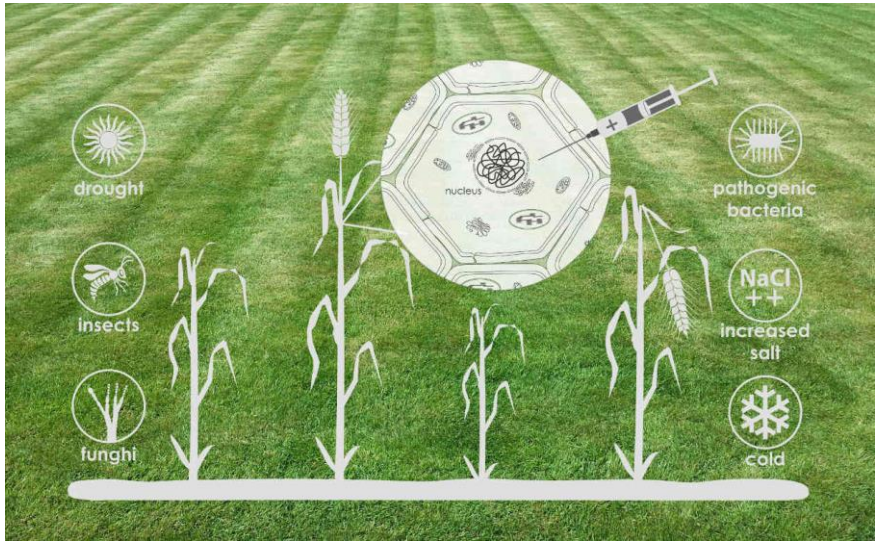


http://gregoryzynda.com/



Real World Applications

- **Agriculture**
  - Crop improvement –stronger, more draught resistant
  - Improving of nutritional quality of livestock, more productive
  - Insect and disease resistant
- **Biotechnology and Microbiology**
  - Waste cleanup
  - Climate change
  - Alternative energy sources
  - Antibiotic resistance



agrojector.com

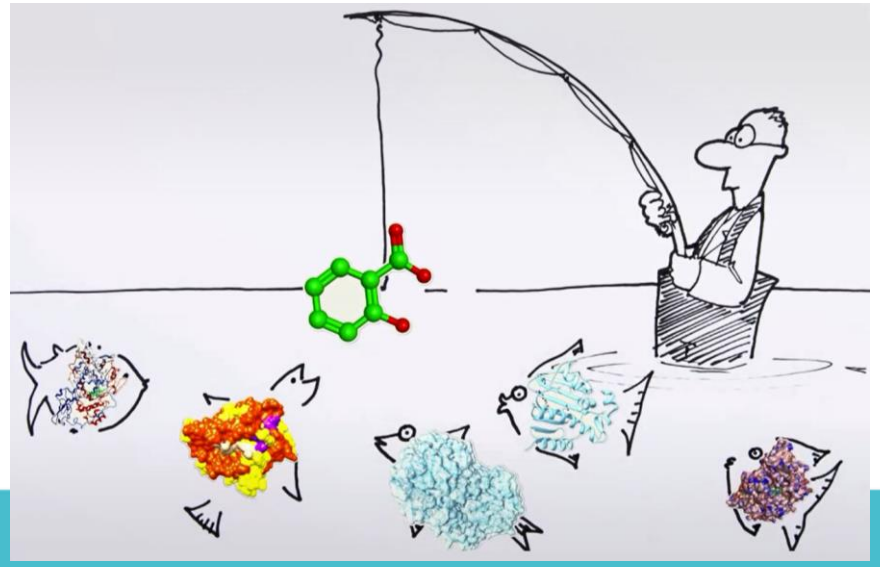
Dupont.com

Real World Applications

- **Aquaculture**
  - Better disease mechanism understanding
  - Vaccine development

environmental-watch.com

- **Biomedicine**
  - Drug discovery
  - Personalized medicine
  - Preventive medicine



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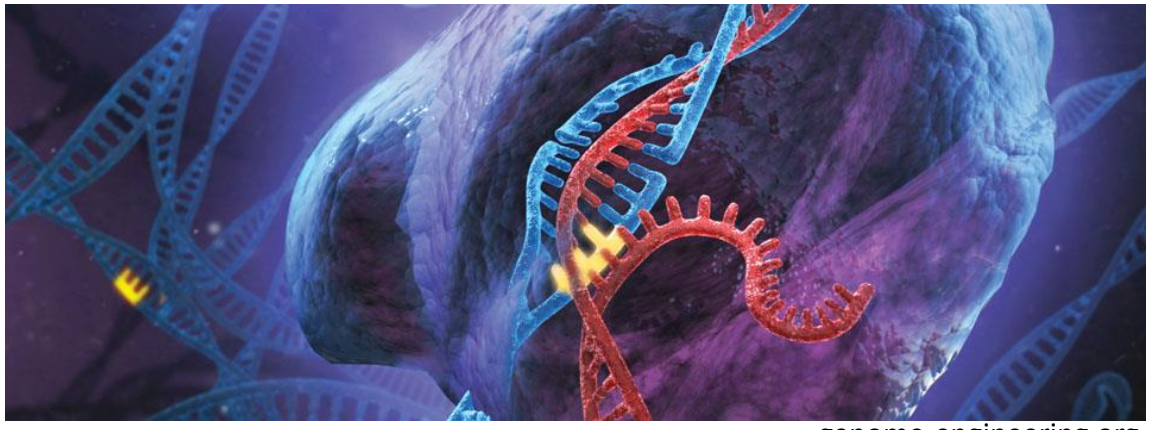
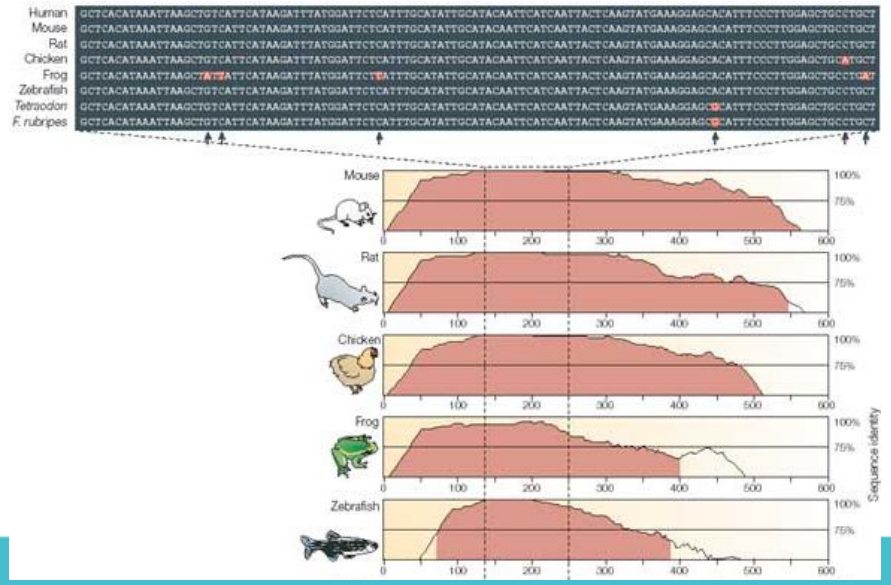
Future Potential

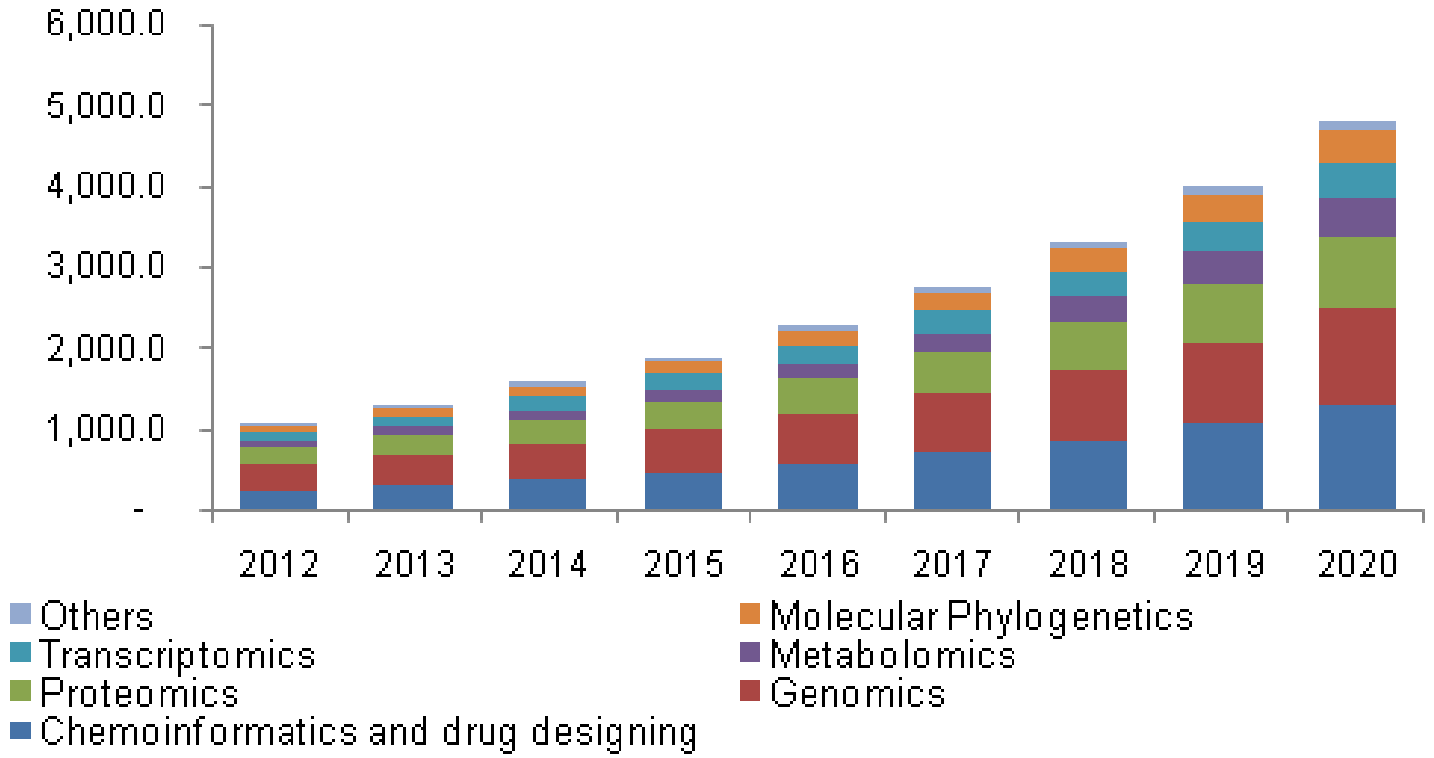
- CRISPR-Cas – targeted genome editing
  - CRISPR repeat identification search for regularly interspaced repeats
  - Design a target sequence for the guide RNA
  - Identification of *cas* genes
  - Finding the protospacer adjacent motifs
- Comparative Genomics
  - Common features of different organisms are encoded in DNA
  - Looking at these features points to similarities and difference
  - Relevant organisms could be used a models to study human diseases



genome-engineering.org



European Bioinformatics Market, 2012 - 2020 (USD Million)



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Summary of Bioinformatics Applications