Cloud Computing Project Topics Handout

Description

The project handout gives you a list of wanted ideas/keywords that you shall come up for your project. In your group (**up to 2 people**), you need to decide the exact title of your project based on the keyword and the possible contributions. With all that, you shall send your project paper and the uploaded docker image link from docker hub to me via **ncuhomework@outlook.com**.

Wrap Computer Visualization in a Cloud Instance

Visualizable objects in biology and medicine extend across a vast range of scale, from individual molecules and cells through the varieties of tissue and interstitial interfaces to complete organs, organ systems, and body parts.

The practice of medicine and study of biology have always relied on visualizations to study the relationship of anatomic structure to biologic function and to detect and treat disease and trauma that disturb or threaten normal life processes. Traditionally, these visualizations have been either direct, via surgery or biopsy, or indirect, requiring extensive mental reconstruction. The potential for revolutionary innovation in the practice of medicine and in biologic investigations lies in direct, fully immersive, real-time multi sensory fusion of real and virtual information data streams into online, real-time visualizations available during actual clinical procedures or biological experiments. In the field of scientific visualization, the term "four dimensional visualization" usually refers to the process of rendering a three dimensional field of scalar values.

"4D" is shorthand for "four-dimensional"- the fourth dimension being time. 4D visualization takes three-dimensional images and adds the element of time to the process. The revolutionary capabilities of new three-dimensional (3-D) and four-dimensional (4-D) medical imaging modalities along with computer reconstruction and rendering of multidimensional medical and histologic volume image data, obviate the need for physical dissection or abstract assembly of anatomy and provide powerful new opportunities for medical diagnosis and treatment, as well as for biological investigations.In contrast to 3D imaging diagnostic processes, 4D allows doctor to visualize internal anatomy moving in real-time. So physicians and sonographers can detect or rule out any number of issues, from vascular anomalies and genetic syndromes. Time will reveal the importance of 4d visualization.

Topics

- **RAY Tracing Algorithm in a Docker Image**: Raytracing solves several rendering problems in a straight-forward manner, including hidden surfaces, shadows, reflection, and refraction. In addition, raytracing is not restricted to rendering polygonal meshes; it can handle any object that can be interrogated to find the intersection point of a given ray with the surface of the object. This property is especially nice for rendering four-dimensional objects, since many N-dimensional objects can be easily described with implicit equations

- **4D IMAGE WARPING in a Docker Image**: For robustly measuring temporal morphological brain changes, a 4D image warping mechanism can be used. Longitudinal stability is achieved by considering all temporal MR images of an individual simultaneously in image warping, rather than by individually warping a 3D template to an individual, or by warping the images of one time-point to those of another time-point. Moreover, image features that are consistently recognized in all time-points guide the warping procedure, whereas spurious features that appear inconsistently at different time-points are eliminated. This deformation strategy significantly improves robustness in detecting anatomical correspondences, thereby producing smooth and accurate estimations of longitudinal changes. The experimental results show the significant improvement of 4D warping method over previous 3D warping method in measuring subtle longitudinal changes of brain structures.

Data Management Systems as a Service

Teradata is a relational database management system (RDBMS) that drives a company's data warehouse. Teradata provides the foundation to give a company the power to grow, to compete in today's dynamic marketplace, to achieve the goal of "Transforming Transactions into Relationships" and to evolve the business by getting answers to a new generation of questions. Cassandra is open source and is in development at Apache. The Apache Cassandra project brings together Dynamo's fully distributed design and Bigtables Column family based data model.

Topics

- **Symmetric multiprocessing (SMP)**: An SMP Teradata system has a single node that contains multiple CPUs sharing a memory pool.

- **Massively parallel processing (MPP)**: Multiple SMP nodes working together comprise a larger, MPP implementation of Teradata. The nodes are connected using the BYNET, which allows multiple virtual processors on multiple nodes to communicate with each other.

- **Comparing the Cassandra Data Model to a Relational Database**: Cassandra is adapting to recent advances in distributed algorithms like Accural style failure detection and others. Cassandra is proven as it is in use by Digg, Facebook, Twitter, Reddit, Rackspace, Cloudkick, Cisco. The largest production cluster has over 100 TB of data in over 150 machines. It is Fault tolerant, decentralizes and gives the control to

developers to choose between synchronous and asynchronous data replication. It offers rich data model, to efficiently compute using key and value pairs. It is highly scalable both in terms of storage volume and request throughput while not being subject to any single point of failure. It is durable and supports third party applications. Cassandra aims to run on top of an infrastructure of hundreds of nodes (possibly spread across different data centers).

- **Cassandra Architecture**: At this scale, small and large components fail continuously. The way Cassandra manages the persistent state in the face of these failures drives the reliability and scalability of the software systems relying on this service. While in many ways Cassandra resembles a database and shares many design and implementation strategies therewith, Cassandra does not support a full relational data model; instead, it provides clients with a simple data model that supports dynamic control over data layout and format. Cassandra system was designed to run on cheap commodity hardware and handle high write throughput while not sacrificing read efficiency.

DNA Based Computing as a Service

Biology is now the study of information stored in DNA - strings of four letters: A, T, G, and C for the bases adenine, thymine, guanine and cytosine - and of the transformations that information undergoes in the cell. There were mathematics here?

DNA polymerase is the king of enzymes - the maker of life. Under appropriate conditions, given a strand of DNA, DNA polymerase produces a second "Watson-Crick" complementary strand, in which every C is replaced by a G, every G by a C, every A by a T and every T by an A.

For example, given a molecule with the sequence CATGTC, DNA polymerase will produce a new molecule with the sequence GTACAG. The polymerase enables DNA to reproduce, which in turn allows cells to reproduce and ultimately allows you to reproduce. For a strict reductionist, the replication of DNA polymerase is what life is is all about.

Topics

- **Watson-Crick pairing** - every strand of DNA has its Watson-Crick complement.

- **Polymerases** - to copy information from one molecule into another.

- **Ligases** - to bind molecules together.

- **Nucleases** -to cut nucleic acids.

- **Gel electrophoresis** - a process to separate DNA by length.

- **DNA synthesis** - to write a DNA sequence on a piece of paper.

Bio-Molecular Computing as a Service

Molecular computing is an emerging field to which chemistry, biophysics, molecular biology, electronic engineering, solid state physics and computer science contribute to a large extent. It involves the encoding, manipulation and retrieval of information at a macromolecular level in contrast to the current techniques, which accomplish the above functions via IC miniaturization of bulk devices.

The biological systems have unique abilities such as pattern recognition, learning, self-assembly and self-reproduction as well as high speed and parallel information processing. The aim of this article is to exploit these characteristics to build computing systems, which have many advantages over their inorganic (Si,Ge) counterparts.

Topics

- **Adleman's Traveling Salesman Problem in BMC**

Artificial Neural Network (ANN) as a Service

An Artificial Neural Network (ANN) is an information-processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, learn by example.

An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well.

Neural network simulations appear to be a recent development. However, this field was established before the advent of computers, and has survived several eras. Many important advances have been boosted by the use of inexpensive computer emulations. The first artificial neuron was produced in 1943 by the neurophysiologist Warren McCulloch and the logician Walter Pitts.

Topics

- **The beginning of NN**: There were some initial simulations using formal logic. McCulloch and Pitts (1943) developed models of neural networks based on their understanding of neurology. These models made several assumptions about how neurons worked. Their networks were based on simple neurons, which were considered to be binary devices with fixed threshold.

- **The injection of NN**: Not only was neuroscience, but psychologists and engineers also contributed to the progress of neural network simulations. Rosenblatt (1958) stirred considerable interest and activity in the field when he designed and developed the Perceptron. The Perceptron had three layers with the middle layer known as the association layer. This system could learn to connect or associate a given input to a random output unit.

- **The early system of NN**: Another system was the ADALINE (Adaptive Linear Element) which was developed in 1960 by Widrow and Hoff (of Stanford University). The ADALINE was an analogue electronic device made from simple components. The method used for learning was different to that of the Perceptron, it employed the Least-Mean-Squares (LMS) learning rule.

- **The late progress on NN**: Progress during the late 1970s and early 1980s was important to the re-emergence on interest in the neural network field. Significant progress has been made in the field of neural networks-enough to attract a great deal of attention and fund further research.

- **Neurally based chips**: NBC are emerging and applications to complex problems developing. Clearly, today is a period of transition for neural network technology.

Game as a Service###

Video game is usually played on a personal computer rather than a dedicated video game console or arcade machine.Its defining characteristics include: more diverse and user-determined gaming hardware and software; and generally greater capacity in input, processing, and video output. You are asked to make a docker image that contains certain game(s) and make them playable via the image.

Topics

- **Console Games**
- **PC Games**
- **Arcade Games**
- **Smartphone Games**
- **New-era Games**: Games that will adapt new era technique including but not limited to VR/AR devices, wearable devices, etc.

Virtualization###

In computing, virtualization refers to the act of creating a virtual (rather than actual) version of something, including virtual computer hardware platforms, storage devices, and computer network resources.

Topics

- **Hardware Virtualization**
- **Licensing**
- **Containerization**