Problem formulation: Which topic is being examined and why (indicate the corresponding chapter from the Sommerville textbook)? What aspects will be included/excluded? Define your scope.

Problem formulation: Cloud computing, covered in Ch 5 of the Sommerville textbook, has become the dominant force in the computing world. This infographic looks at what enabled this unprecedented expansion. What were the technologies that came together to create this behemoth, what are the histories behind them, and how to did they contribute to the exponential growth that has occurred in this critical segment.

Literature search: Identifying relevant research, you will need to survey at least 3 peer reviewed journal articles or conference papers.

Critical analysis: Critical thinking is the analysis of available facts, evidence, observations, and arguments to form a judgment.

There were three major technologies that came together to create the cloud computing revolution. The first was virtualization, which started appearing in early forms in the early 1960’s and began to hit its stride in 2001 with VMWare’s release of ESX. The next critical enabling technology was the internet. This technology grew from its humble roots, ARPANET in 1969, came of age in the dot com bubble of the late 90’s, and has continued to develop and expand since. The final enabling technology was containers. This technology was first seen in the mid 2000’s, but the release of first Docker and then Kubernetes a decade later propelled the cloud to new heights.

Critical Analysis: The history of cloud computing appears to progress in three main stages. Starting in the 1960’s, development and advancement of virtualization technology laid the groundwork for what was to come. Next came the birth of the internet age in the mid 1990’s, allowing computers across the world to connect and collaborate. The final piece of the puzzle looks to be containerization. First Docker, and then Kubernetes were introduced to the world, causing growth rates of the cloud market to explode.

Evaluation: Reflect on the literature and formulate a personal, well-thought-out response.

Evaluation: The late 2010’s finally saw all three pieces of the cloud computing puzzle come together, and the results were astounding. Cloud computing companies saw their revenues double year-over-year for multiple consecutive years, growth rates that are completely unheard of in any decade old industry. The number of offered SAAS, PAAS, and IAAS products has grown exponentially and the cloud, much like the internet before it, has completely seeped into everyday life.

Most interesting: Geared towards what is most interesting and fascinating about the topic.

Most interesting: The 2015-2022 boom only recently started to cool off, and already cloud computing appears to be headed into a new age, one dominated by the growth of AI. Nvidia, the primary supplier of the hardware used for ML training and inference, saw their datacenter revenues triple in their latest quarter.

References:

(8) Brown, N. (2023, February 17). *The history of SAAS: The New Digital Revolution, explained*. The Growth Marketing Agency – Powered by AI. https://accelerateagency.ai/the-history-of-saas

(3) Conroy, S. (2019, July 5). *History of virtualization*. I Don’t Know, Read The Manual. https://www.idkrtm.com/history-of-virtualization/

(2) Dillenburg, S. (2020, October 15). *A brief history of container virtualization*. Medium. https://medium.com/an-idea/a-brief-history-of-container-virtualization-57fc96c02924

(1) Foote, K. D. (2023, May 4). *A brief history of cloud computing*. DATAVERSITY. https://www.dataversity.net/brief-history-cloud-computing/

(6) *History of AWS - Javatpoint*. www.javatpoint.com. (n.d.). https://www.javatpoint.com/history-of-aws

(9) IEEE Computer Society. (2012, December 15). *Compatible Time-Sharing System (1961 -1973) fiftieth anniversary ...* Compatible Time-Sharing System (1961-1973) Fiftieth Anniversary Commemorative Overview. https://multicians.org/thvv/compatible-time-sharing-system.pdf

(5) Jebaraj, K. (2023, September 7). *Cloud computing future: 12 trends & predictions about cloud*. KnowledgeHut. https://www.knowledgehut.com/blog/cloud-computing/cloud-computing-future

(4) Osnat, R. (2023, June 20). *A brief history of containers: From the 1970s till now*. Cloud native applications security. https://blog.aquasec.com/a-brief-history-of-containers-from-1970s-chroot-to-docker-2016

(11) Osnat, R. (2023, June 20). *A brief history of containers: From the 1970s till now*. Cloud native applications security. https://blog.aquasec.com/a-brief-history-of-containers-from-1970s-chroot-to-docker-2016

(10) Sharwood, S. (2023, November 22). *Nvidia revenue explodes, led by datacenter products*. The Register® - Biting the hand that feeds IT. https://www.theregister.com/2023/11/22/nvidia\_q3\_2023/

(7)Varghese, B. (2023, October 11). *History of the cloud*. BCS. https://www.bcs.org/articles-opinion-and-research/history-of-the-cloud/

Literature Search

Islam, M., & Reza, S. (2019). The rise of Big Data and cloud computing. *Internet of Things and Cloud Computing*, *7*(2), 45–53. https://doi.org/10.11648/j.iotcc.20190702.12

Oludele, A., C. Ogu, E., ‘Shade, K., & Chinecherem, U. (2014). On the evolution of virtualization and cloud computing: A Review. *Journal of Computer Sciences and Applications*, *2*(3), 40–43. https://doi.org/10.12691/jcsa-2-3-1

Randal, A. (2020). The ideal versus the real. *ACM Computing Surveys*, *53*(1), 1–31. https://doi.org/10.1145/3365199

Draft:

1961 – MIT successfully demonstrates CTSS (Compatible Time-Sharing System), which allowed several terminals to timeshare a single mainframe (9)

1963 – Project MAC, DARPA and MIT collaboration to develop a “computer to be used by two or more people, simultaneously”. (virtualization) (1)

1969 – ARPANET (internet) (1)

1970 – IBM releases the first commercial mainframe to support virtualization (virtualization) (3)

1979 – UNIX a implements chroot, the first concept of container virtualization (virtualization, containers) (2)

1987 – Insignia Solutions demonstrates SoftPC, a software emulator that allowed users to run Dos application on Unic workstations (virtualization) (3)

1994 – Netscape Navigator introduces SSL protocol, enabling secure data transmission over the internet (8)

1996 – First use of the term “cloud computing” in an internal memo from Compaq (11)

1999 – Salesforce releases CRM, the first true SAAS product (SAAS) (1)

2001 – VMWare releases the GSX Server, a Type-2 Hypervisor (runs VM on top of a host OS), and the ESX Server, a Type-1 Hypervisor (does not require a host OS) (virtualization) (3)(13)

2004 – First primitive container released (Solaris containers) (containers) (1)

2006 – AWS and Google Docs released (cloud) (1)

2007 – VMWare releases VDI, the first virtual desktop (virtualization) (3)

2010 – Microsoft Azure released (cloud). The term “big data” coined (12)

2011 – Hybrid clouds first introduced (cloud) (1)

2013 – Docker released (containers) (1)

2014 – Kubernetes, a contain orchestration service that works well with microservice architectures released (containers) (2)

2015/2016 – Cloud computing exploded. AWS revenues nearly double in consecutive years (cloud) (6)

2017 – Kubernetes becomes mainstream. Microsoft Azure released AKS (Azure Kubernetes Service) and AWS releases EKS (Elastic Kubernetes Service) (containers, cloud) (4)

2018 – Google makes Tensor Processing Units (TPUs) available via Google Cloud (7)

2019 – Kubernetes becomes the gold standard. AWS, Azure, Google, and IBM all released Kubernetes-based hybrid-cloud capabilities. (containers, cloud) (4)

2023 – Nvidia datacenter revenue triples YoY on the back of growth in the demand for AI

Future – Three trends: Continued growth of hybrid and multi-cloud. Growth of edge computing. Rapidly expanding AI and ML offerings. (5)