Running R from Amazon's Elastic Compute Cloud

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Building a AMI

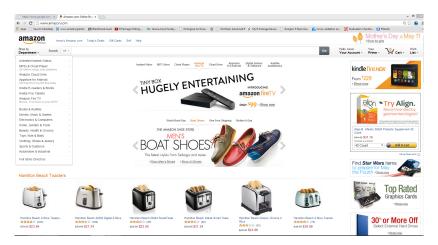
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Introduction



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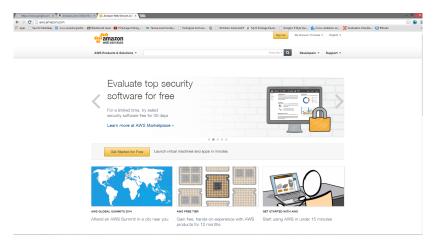
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Amazon Web Services







CloudWatch Resource and Application Monitoring

Elastic Beanstalk



DevOps Application Management Service



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EC2

Elastic Compute Cloud (EC2)

- On demand, scalable cloud computing service provided by Amazon.
- You pay for the service when you need it.
- You pay only for the amount you use.
- There are other ways to purchase (e.g., bidding on unused services, renting a server).



- Instance = Node
- Amazon Machine Image (AMI) = operating system + programs
- Instance + AMI = "virtual computer"

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- Instance = Node
- Free tier (750 hours EC2 running Linux/Unix Micro Instance and 750 hours running Microsoft Windows Servers Micro Instance)
- http://aws.amazon.com/ec2/pricing/



- vCPU = threads
- ECU = One EC2 Compute Unit provides the equivalent CPU capacity of a 1.0-1.2 GHz 2007 Opteron or 2007 Xeon processor.
- Memory (GiB) = RAM
- Instance Storage (GB) = "hard drive" storage
- SSD = solid state drive
- http://aws.amazon.com/ec2/pricing/

Amazon Machine Image

- Amazon Machine Image (AMI) = operating system + programs
- Build your own AMI
- You can save, sell, or share your AMI
- Pre-made AMI (e.g., Revolution Analytics https://aws.amazon.com/marketplace/seller-profile? id=3c6536d3-8115-4bc0-a713-be58e257a7be

Pre-made AMI Building a AMI



- Louis Aslett (postdoc at Oxford)
- See link below and follow instructions or my video tutorial on Black Board
- Demonstration
- http://www.louisaslett.com/RStudio_AMI/

Pre-made AMI Building a AMI



- Easy to install packages
- Easy to upload files (e.g., R code)
- Run Rstudio from web browser
- Easy to change instance size/type
- I have not found an easy way to install other software with pre-made AMIs (e.g., JAGS, LYX/knitr).

Pre-made AMI Building a AMI

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Building your own AMI

- Equivalent to customizing your own computer
- You can put whatever programs you want on your own AMI
- You can choose the operating system

Pre-made AMI Building a AMI

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Building your own AMI

- "Launching an instance" = first step to building and running your virtual machine
- Choose a AMI

Pre-made AMI Building a AMI

Building your own AMI

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		achine Image (AMI)	Cancel and Exit
		guration (operating system, application server, and applications) required to launch your instance. You can select an AMI provided by AWS, our user community, or the AWS Marketplace, or you can se	elect one of your own AMIs.
uick Start			$ \langle \ <\ 1$ to 18 of 18 AMIs $\ >\ > $
My AMIs		Amazon Linux AMI 2014.03.1 - ami-fb8e9292 (64-bit) / ami-178e927e (32-bit)	Select
AWS Marketplace	Amazon Linux Free Ser eligible	The Amazon Linux AMI is an EBS-backed image. It includes Linux 3:10, AWS tools, Java 7. Ruby 2, and repository access to multiple versions of Apache, MySGL, PostgreBQL, Pytten, Ruby and Torncat.	€64.b# © 32.b#
Community AMIs		Red Hat Enterprise Linux 8.4 (PV) - ami-a25415cb (04-bit) / ami-7e175617 (32-bit)	Select
Free tier only (1)	Red Hat	Red Hat Enterprise Linux version 6.4 (PV), EBS-backed	R ALM C 124
or needed only (f)	Free ter eligible	Root device type: also VHsuitzation type: paravirtual	@ 64-64 U 32-64
	3	SuSE Linux Enterprise Server 11 sp3 (PV) - ami-66084881 (64-bit) / ami-b60948df (32-bit)	Select
	SUSE Linux	SuBE Linux Enterprise Server 11 Service Pack 3 (PV), EBS-backed with Amazen EC2 AMI Tools preinstalled; Apache 2.2, MySQL 5.5, PHP 5.3, and Ruby 1.8.7 available	# 64.b# © 32.b#
	Free Ser eligible	Roct device type: eds Virtualization type: paravirtual	
	۲	Ubuntu Server 14.04 LTS (PV) - ami-018c9588 (84-bit) / ami-358c955c (32-bit)	Select
	Tree for election	Ubuntu Server 14. 64 LTS (PV), EBS-backed with support available from Canonical (http://www.ubuntu.com/cloud/services). Enciderios tros: els	€ 64-64 © 32-64
		Amazon Linux AMI (HVM) 2014.03.1 - ami-973d911c The Amazon Linux AMI is an EBS-backed image. It includes Linux 3.10. AWS tools, Jave 7, Ruby 2, and receivory access to multiple vestions of Acache. McGQL. PostoreBQL. Porteer, Ruby and Torncat.	Select
	Amazon Linux	Root device type eta Vitualization type trvi	64-bit
		Red Hat Enterprise Linux 6.5 (HVM) - ami-0306010a	Select
		Red Hat Enterprise Linux version 6.5 (IVM), EDS-backed	64-04
	Red Hat	Root device type: alse Virtualization type: two	
	3	SuSE Linux Enterprise Server 11 sp3 (HVM) - ami-e572438c	Select
	SUSE Linux	SuSE Linux Enterprise Server 11 Service Pack 3 (HVM), EBS backed. Noidia driver installs automatically during startup for OPU instances.	64-bit

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Feedback

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Pre-made AMI Building a AMI

Building your own AMI

- Many different option (18 as of 4/24/2014)
- Linux dominates the list and is cheaper

Windows Server



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Pre-made AMI Building a AMI

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Building your own AMI

- Not enough time in this presentation to build a Windows Server AMI
- See tutorial video on Black Board
- Demonstration of Window Server and R

Parallel computing assignment revisited

- All times reported were using the foreach package
- My computer is a Lenovo Y510p with an Intel i7-4700MQ processor (3.4 GHz) with four cores and 16 GB of RAM.
- I tested the t1.micro, m3.xlarge and c3.2xlarge instances

Parallel computing assignment revisited

	vCPU	ECU	Memory (GiB)	Instance Storage (GB)	Windows Usage			
General Purpose - Current Generation								
m3.medium	1	3	3.75	1 x 4 SSD	\$0.133 per Hour			
m3.large	2	6.5	7.5	1 x 32 SSD	\$0.266 per Hour			
m3.xlarge	4	13	15	2 x 40 SSD	\$0.532 per Hour			
m3.2xlarge	8	26	30	2 x 80 SSD	\$1.064 per Hour			
Compute Optimized - Current Generation								
c3.large	2	7	3.75	2 x 16 SSD	\$0.188 per Hour			
c3.xlarge	4	14	7.5	2 x 40 SSD	\$0.376 per Hour			
c3.2xlarge	8	28	15	2 x 80 SSD	\$0.752 per Hour			
c3.4xlarge	16	55	30	2 x 160 SSD	\$1.504 per Hour			
c3.8xlarge	32	108	60	2 x 320 SSD	\$3.008 per Hour			

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Parallel computing assignment revisited

Computer/instance	Number of threads	Time
Lenovo	1	4.45
Lenovo	2	2.41
Lenovo	8	1.24
t1 micro (free)	1	9.55
m3.xlarge	4	2.76
c3.2xlarge	4	1.48
c3.2xlarge	8	1.17

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Stopping vs. terminating instances

- You will be charged if you leave an instance running (or you will use up all of your free tier hours)
- You will not be charged for computing resources if you stop the instance.
- You can re-start any stopped instance.
- You will be charged for storage on any stopped instance (I think ~\$0.05 per GB per month)

Stopping vs. terminating instances

- You can terminate an instance, but your AMI will be lost.
- After terminating a node, no charges will occur.

Thoughts about cloud computing

- A real life problem faced by grad students: which laptop to purchase?
- I recently purchased a Lenovo Y510p with an Intel i7-4700MQ processor (3.4 GHz) and 16 GB of RAM
- Cost was ~\$1100
- I use my laptops full computing capability <5% of the time.
- The equivalent spec system on the EC2 is about \$0.75 an hour.
- My laptop is not future proof
- EC2 is future proof

How I am going to use it

- Amazon's EC2 is portable
- Window Server 2012 is convenient for Windows users
- RStudio on the server facilitates collaboration

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