User interfaces for distributed systems

COEN-317: Distributed Systems Robert Bruce Department of Computer Science and Engineering Santa Clara University



Motivation

Why develop a Graphical User Interface (GUI) for distributed systems?

- 1. To monitor the distributed system
 - Ordinary user may view a queue to determine ETA (estimated time to completion) of tasks.
 - Administrative users may view log files and job completion statistics to identify anomalies such as machine failures.
 - Developers of distributed systems may monitor the system for testing purposes to diagnose programming errors.
- 2. To manage the distributed system
 - Administrative users may override the queue by disabling or suspending jobs manually.

GUI development for distributed systems: practical advice

Suggestions when developing a GUI for distributed systems:

- Choose a graphical universal interface that is operating system agnostic (i.e. cross platform) and hardware independent.
- Develop multiple levels of user interface functionality in your distributed system: read-only, user, administrator, developer.

GUI development for distributed systems: practical advice

There are many choices for GUI toolkit (e.g. Qt, GTK, Java Swing, wxWidgets, etc.).

• Unfortunately, GUI toolkits can fall behind in development and/or become obscure or no longer supported.

In my experience, the best route is a web-based (HTML) interface for distributed systems.

- Web interfaces are quite capable of handling the tasks necessary to monitor and manage a distributed system.
- HTML is well documented, ubiquitous, and backed by a standards committee (W3C).
- HTML support tends to degrade gracefully as the HTML standard evolves.

For non-web based GUI toolkit, I recommend:

• Qt

Web-based GUI: advantages and disadvantages

What are the advantages with web-based interfaces?

- Capable of rendering user-interfaces and content cross-platform on both desktop and mobile devices, tablets, etc.
- Operating system independent
- Hardware independent

What are the disadvantages with web-based interfaces?

- Web-based applications can become unnecessarily complicated with bloated front-end Javascript libraries.
- HTTP is a stateless protocol. You will need to implement some sort of session management to maintain state in sophisticated web-based interfaces.

Architectural design considerations for web-based interfaces:

- All processing split between server-side and client-side.
- All processing conducted one client-side using Javascript and CSS or Java.

Web-based GUI: Beginning development suggestions

When you begin developing web-based user interfaces for distributed systems:

- Keep the interface sparse.
- Start with a simple, fixed-resolution interface. I suggest implementing the interface on a desktop or tablet display with a large screen. Then test that interface to see if it is comfortable to view and interact with.
- Design the user interface in stages. For example, begin with a read-only interface. Then create a management interface (which would require login functionality authentication).
- Once the interface layout is acceptable, begin designing interfaces for various screen resolutions.
- In time you can make the interface responsive and adjustable to various screen resolutions.

Web-based GUI: helper libraries

When developing web-based user interfaces for distributed systems, I recommend the following:

Bootstrap

https://getbootstrap.com/

React

https://reactjs.org/

• jQuery

https://jquery.com/

What should be implemented in a GUI for distributed systems?

1. Job management (manual override)

- Designate a master queue machine (IP address or MAC address)
- Suspend operation of a backup queue machine (IP address or MAC address)
- Resume operation of a backup queue machine (IP address or MAC address)
- Delete pending jobs in master queue (all jobs or specific jobs)
- Delete in-progress jobs in master queue (all jobs or specific jobs)
- Delete error messages (all errors messages or specific error messages)
- 2. Queue monitor (read-only)
 - IP address of master queue
 - IP addresses of backup queue machine (identified as backup queues in case master queue fails)
- 3. Job statistics: worker machines (read-only)
 - Number of pending jobs
 - Number of in-progress jobs
 - Number of completed jobs
 - Number of suspended jobs (possibly due to machine failure)
 - Average job completion time (all worker machines)
 - Average job completion time (particular worker machine)
 - Average CPU utilization (all worker machines)
 - Average CPU utilization (particular worker machine)
- 4. Error message statistics: worker machines (read-only)
 - Number of error messages reported (all worker machines and queue manager machines)
 - Type of error message reported (network failure, drive failure, etc.)

BOINC interface

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Deadline interface

			Jobs			ť	J X
🔽 👤 🏹 🚫 15105 total, 1397 rendering, 13	3594 queued, 69 com	oleted, 2 pe	ending, 40 suspended, 3	failed, 1 selected	Search		•
Job Name	User	Errors	Task Progress	Status	Submit Date/Time	▼ Start Date/Time	
🕼 Maximum Revenge v004	nicolas.ryan	0	0 % (0/90)	Queued	2014/10/22 12:33:46		
Ae Sarcastic downwards priest failure v0	vincent.carlson	0	75 % (405/5 <mark>3</mark> 6)	Rendering (3)	2014/10/22 12:33:46	2014/10/22 12:33:5	7
Maximum Revenge v005	timothy.robertson	0	0 % (0/154)	Queued	2014/10/22 12:33:46		
Dord of all stations v004	jean.farmer	0	93 % (31/33)	Queued	2014/10/22 12:33:47	2014/10/22 12:36:0	2
😚 Probably debated bucket v002	derek.underwood	0	4 % (4/85)	Rendering (1)	2014/10/22 12:33:47	2014/10/22 14:03:0	0
Probably just a cube v001	sandy.allison	0	12 % (86/663)	Rendering (1)	2014/10/22 12:33:47	2014/10/22 12:35:3	8
📕 Mild Pun Blasting v004	patsy.owens	0	0 % (0/116)	Queued	2014/10/22 12:33:47		
🔊 Breach philosophical subscription v004	winifred.holt	0	0 % (0/356)	Queued	2014/10/22 12:33:47		
Divesting reinforced stars v002	ronald.reid	0	0 % (0/177)	Queued	2014/10/22 12:33:47		
Maximum Revenge v007	rap.man	0	98 % (187/189)	Queued	2014/10/22 12:33:47	2014/10/22 12:34:2	9
Fine associated mummy v003	alex.lynch	0	29 % (167/557)	Rendering (1)	2014/10/22 12:33:47	2014/10/22 12:33:5	6
Twice dry plaster v004	hurdy.gurdy	0	0 % (0/60)	Queued	2014/10/22 12:33:47		
Likely not spheres v002	greg.tucker	0	98 % (90/91)	Queued	2014/10/22 12:33:47	2014/10/22 12:34:3	3
Sarcastic downwards priest failure v0	perry.summers	0	0 % (0/356)	Queued	2014/10/22 12:33:47		
Flip welcomed irony v003	ronald.reid	0	0 % (0/48)	Queued	2014/10/22 12:33:47		
🗾 Mild Pun Blasting v006	charlene.taylor	0	0 % (0/79)	Queued	2014/10/22 12:33:47		
F6 Barring unset fortune v002	bryan.davis	0	0 % (0/17)	Queued	2014/10/22 12:33:47		
Musde Mass eXpedition v004	ronald.reid	0	0 % (0/94)	Queued	2014/10/22 12:33:47		
📕 Antiqued digestible donkey v001	shannon.garcia	0	99 % (127/128)	Queued	2014/10/22 12:33:47	2014/10/22 12:33:5	7
🕼 The Hurdy Gurdy Man v006	marcos.douglas	0	0 % (0/148)	Queued	2014/10/22 12:33:48		
Probably just a cube v002	alex.lynch	0	0 % (0/182)	Queued	2014/10/22 12:33:48		
Opposite Textual Five v000	patsy.owens	0	70 % (93/1 <mark>3</mark> 2)	Rendering (1)	2014/10/22 12:33:48	2014/10/22 12:35:2	9
Fantastic chief crown Deadline v004	nicolas.ryan	0	0 % (0/170)	Queued	2014/10/22 12:33:48		
Ae Twice dry plaster v005	dean.green	0	50 % (57/114)	Rendering (1)	2014/10/22 12:33:48	2014/10/22 12:36:1	.4
😚 Bad Catalogue Rising: Revengeance	marcos.douglas	0	0 % (0/61)	Queued	2014/10/22 12:33:48		
Connect Potent Passion v002	crain.olson	0	0 % (0/40)	Oueued	2014/10/22 12:33:48		

OpenCue interface



Image source: https://www.opencue.io/docs/user-guides/monitoring-your-jobs/

Prism Pandora interface

Render Handler

🔋 Render Handler																			
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2 shot_Pencil-p-060_F	FX_FX-Strings_v0039_rer	nderkickoff_mkomain	rendering	47 %	51	1001-1081	31.01.2018 23:03	:13 Notion	Manuel Koester	Hou	Num	Frames St	atus	Slave	Rendertime	Start	End		
³ shot_Pencil-p-050_F	FX_FX-Strings_v0034_tim	reshiftOff_mkomain	finished				31.01.2018 22:43	12 Notion	Manuel Koester		00	1001-1005 fir	ished	MEDIA-MM-04	00:20:18	31/01/18 23:4	4:22 01/02/18 00:04:41		
4 shot_Pencil-p-040_F	FX_FX-Strings_v0046_po	lies_mkomain							Manuel Koester			1006-1010 fir	ished	MEDIA-MM-02	00:20:15	31/01/18 23:5	2:01 01/02/18 00:12:16		
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6 shot_Acryl-a-090_sin	m_FX-Fluid_v0013_freeH	lead_rfrFluidGeo							Richard Frangenb	erg Hou	03	1016-1020 fir	ished	MEDIA-MM-03	00:20:45	01/02/18 00:0	6:35 01/02/18 00:27:21		
7 shot_Acryl-a-130_rei	n_Rendering_v0008_clo	udsFix_rfrmain	rendering						Richard Frangent	erg Hou	04	1021-1025 fir	ished	MEDIA-MM-04	00:20:41	01/02/18 00:0	7:40 01/02/18 00:28:21		
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10 shot_Acryl-a-070_ren	n_Rendering_v0008_clo	udsFix_rfrmain					31.01.2018 12:19		Richard Frangenb		07	1035-1040 fir	ished	AG-PWkst-02	00-14-24	01/02/18 00:1	7:32 01/02/18 00:31:56		
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15 shot_Acryl-a-090_rei	n_Rendering_v0014_clo	udsFix_rfrmain					31.01.2018 00:06		Richard Frangent	erg Hou	12	1061-1065 re	ndering	AG-PWkst-03		01/02/18 00/3	3:49		
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3 AG-PWkst-03	rendering	shot Pencil-p-060 FX FX-String	s v0039 ren					32 Gb 16	[1] 31/01/18 23:4	49:33 : [Redshift 49-33 : Denderin	tjRS render	object initialized (from 1040 to 1	successfi						
4 AG-PWkst-04	rendering	shot Pencil-p-060 FX FX-String	is v0039 ren	derkickoff		ma 1 min.		32 Gb 16	[1] 31/01/18 23:4	49:33 : 23:34:15	5 Redshift_F	OP1 frame 1040	(1 of 5)						
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rendering	shot Pencil-p-060 FX FX-Strings v0039 renderkickoff mkoma			32 Gb		11 31	/01/18 23:49:3 /01/18 23:49:3	3: [vedshtt]k5:render object initialized successfully 3: Rendering 5 frames (from 1040 to 1044 by 1)	
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						11 31	/01/18 23:49:3	, (reclaming) monitoring the Across system : Redshift(Acvs initialized successfully	
						[1] 31	/01/18 23:49:3	3 : [Redshift]Loading the RS scene	
disabled		0 min.	0	32 Gb	8		01/18 23:49:3	: [Redshift]Loading the camera data	
rendering	shot Pencil-p-060 FX FX-Strings v0039 renderkickoff mkoma	0 min.		32 Gb		11 31	01/18 23:49:3	: RedshiftDracessing the scene GD mesh noues data	
rendering	shot Pencil-p-060 FX FX-Strings v0039 renderkickoff mkoma	1 min.		32 Gb		[1] 31	/01/18 23:49:3	3 : [Redshift]Building the additional objects extraction list from the instancer objects	
rendering	shot Pencil-p-060 FX FX-Strings v0039 renderkickoff mkoma	1 min.		32 Gb		[1] 31	/01/18 23:49:3	3 : [Redshift]Disabled objects to be extracted and used as base instance objects: 0	
paused		1 min.		32 Gb	8	Dedd	/01/18 23:49:3. pift1	3;	
rendering	shot Acryl-a-130 ren Rendering v0008 cloudsFix rfrmain (tas	0 min.	8	32 Gb	8	[1] 31	/01/18 23:49:3	3 : [Redshift]Rendering frame	
rendering	shot Pencil-p-060 FX FX-Strings v0039 renderkickoff mkoma	0 min.	0	32 Gb	8	[1] 31	/01/18 23:49:3	1 by a consistence of the second s	
						[Reds	101/18 23·49·3	e Produktif) i rense arni ired	
						1 31	/01/18 23:49:3	: [Redshift]License for redshift-core 2018.07 valid until Aug 01 2018	
						[1] 31	01/18 23:49:3	3 : [Redshift]Rendering time: 15m:16s (1 GPU(s) used)	
						[1] 31	01/18 23:49:3	3: [Redshift]Processing the AOVs list and writting files	
						1 31	/01/18 23:49:3	2: Upedia/IDErana zardarina dona	
						11 31	/01/18 23:49:3	; [Redshift]ROP node "Redshift ROP1' scene extraction time 0.70 sec, render time 916.32 sec, total time 917.02 sec	
						[1] 31	/01/18 23:49:3	3 : 23:49:32 Redshift_ROP1 frame 1041 (2 of 5)	
						[1] 31	01/18 23:49:3	3 : [Redshift]ROP node 'Redshift_ROP 1' rendering frame 1041 (time: 43.33333)	
						Logsize	: 0.64mb	Filter Level: 💌 0	*
	rendering userActive disabled not responding disabled rendering rendering paused rendering not responding	rendering shot_Pencil-p-060_FX_FX-Strings_v0039_renderkickoff_mkoma userActive disabled rendering shot_Pencil-p-060_FX_FX-Strings_v0039_renderkickoff_mkoma rendering shot_Pencil-p-060_FX_FX-Strings_v0039_renderkickoff_mkoma paused rendering shot_Pencil-p-060_FX_FX-Strings_v0039_renderkickoff_mkoma paused rendering shot_Pencil-p-060_FX_FX-Strings_v0039_renderkickoff_mkoma rendering shot_Pencil-p-060_FX_FX-Strings_v0039_renderkickoff_mkoma rendering shot_Pencil-p-060_FX_FX-Strings_v0039_renderkickoff_mkoma	rendering shot_Pencil-p-060_FX_FX-Strings_v0039_renderkickoff_mkoma 1 min. userActive 20 17h 29 m 7d 10h 20 m disabled 7d 10h 20 m 7d 10h 20 m not responding 0 min. 3h 10 min. rendering shot_Pencil-p-060_FX_FX-Strings_v0039_renderkickoff_mkoma 0 min. rendering shot_Pencil-p-060_FX_FX-Strings_v0039_renderkickoff_mkoma 1 min. paused 1 min. 1 min. rendering 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Image source: https://prism-pipeline.com/wp-content/uploads/2018/03/RH004c.jpg

Grafana interface to monitor Kafka message queue



Image source: https://grafana.com/static/assets/img/blog/kafka_integration_ksqldb.png

For further reading

BOINC https://boinc.berkeley.edu/

AWS Thinkbox Deadline https://aws.amazon.com/thinkbox-deadline/

OpenCue https://www.opencue.io/

Prism https://prism-pipeline.com/

Grafana

https://grafana.com/solutions/kafka/monitor/