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VVUQ app

Slides for Andy Davis

Ada Lovelace Centre Funding

“The Ada Lovelace Centre (ALC), is an integrated, cross-disciplinary data intensive science centre, for better exploitation of research carried out at large scale National Facilities including the Diamond Light Source, the ISIS Neutron and Muon Facility, the Central Laser Facility and CCFE.”

→ **Collaboration between STFC and CCFE to develop generic VVUQ software**

Diagram for the computation by the Engine of the Numbers of Bernoulli. See Note G. (page 723 et seq.)

Number of Operations.	Variables and operations.	Variables receiving results.	Indication of change in the value of any Variable.	Statement of Results.	Data.										Working Variables.										Result Variables.			
					V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8	V_9	V_{10}	V_{11}	V_{12}	V_{13}	V_{14}	V_{15}	V_{16}	V_{17}	V_{18}	V_{19}	V_{20}	V_{21}	V_{22}	V_{23}	
1	$\times V_1 \times V_2$	$V_3 = V_1 V_2$		$= 2n$	1	2	n																					
2	$- V_3 - V_1$	$V_4 = V_3 - V_1$		$= 2n - 1$				1																				
3	$+ V_4 + V_1$	$V_5 = V_4 + V_1$		$= 2n + 1$					1																			
4	$- V_5 - V_1$	$V_6 = V_5 - V_1$		$= 2n - 1$						1																		
5	$+ V_6 + V_1$	$V_7 = V_6 + V_1$		$= 2n + 1$							1																	
6	$- V_7 - V_1$	$V_8 = V_7 - V_1$		$= 2n - 1$								1																
7	$+ V_8 + V_1$	$V_9 = V_8 + V_1$		$= 2n + 1$									1															
8	$- V_9 - V_1$	$V_{10} = V_9 - V_1$		$= 2n - 1$										1														
9	$+ V_{10} + V_1$	$V_{11} = V_{10} + V_1$		$= 2n + 1$											1													
10	$- V_{11} - V_1$	$V_{12} = V_{11} - V_1$		$= 2n - 1$												1												
11	$+ V_{12} + V_1$	$V_{13} = V_{12} + V_1$		$= 2n + 1$													1											
12	$- V_{13} - V_1$	$V_{14} = V_{13} - V_1$		$= 2n - 1$														1										
13	$+ V_{14} + V_1$	$V_{15} = V_{14} + V_1$		$= 2n + 1$															1									
14	$- V_{15} - V_1$	$V_{16} = V_{15} - V_1$		$= 2n - 1$																1								
15	$+ V_{16} + V_1$	$V_{17} = V_{16} + V_1$		$= 2n + 1$																	1							
16	$- V_{17} - V_1$	$V_{18} = V_{17} - V_1$		$= 2n - 1$																		1						
17	$+ V_{18} + V_1$	$V_{19} = V_{18} + V_1$		$= 2n + 1$																			1					
18	$- V_{19} - V_1$	$V_{20} = V_{19} - V_1$		$= 2n - 1$																				1				
19	$+ V_{20} + V_1$	$V_{21} = V_{20} + V_1$		$= 2n + 1$																					1			
20	$- V_{21} - V_1$	$V_{22} = V_{21} - V_1$		$= 2n - 1$																						1		
21	$+ V_{22} + V_1$	$V_{23} = V_{22} + V_1$		$= 2n + 1$																							1	
22	$- V_{23} - V_1$	$V_{24} = V_{23} - V_1$		$= 2n - 1$																							1	
23	$+ V_{24} + V_1$	$V_{25} = V_{24} + V_1$		$= 2n + 1$																							1	
24	$- V_{25} - V_1$	$V_{26} = V_{25} - V_1$		$= 2n - 1$																							1	
25	$+ V_{26} + V_1$	$V_{27} = V_{26} + V_1$		$= 2n + 1$																							1	

Here follows a repetition of Operations thirteen to twenty-three.

Uncertainty Quantification

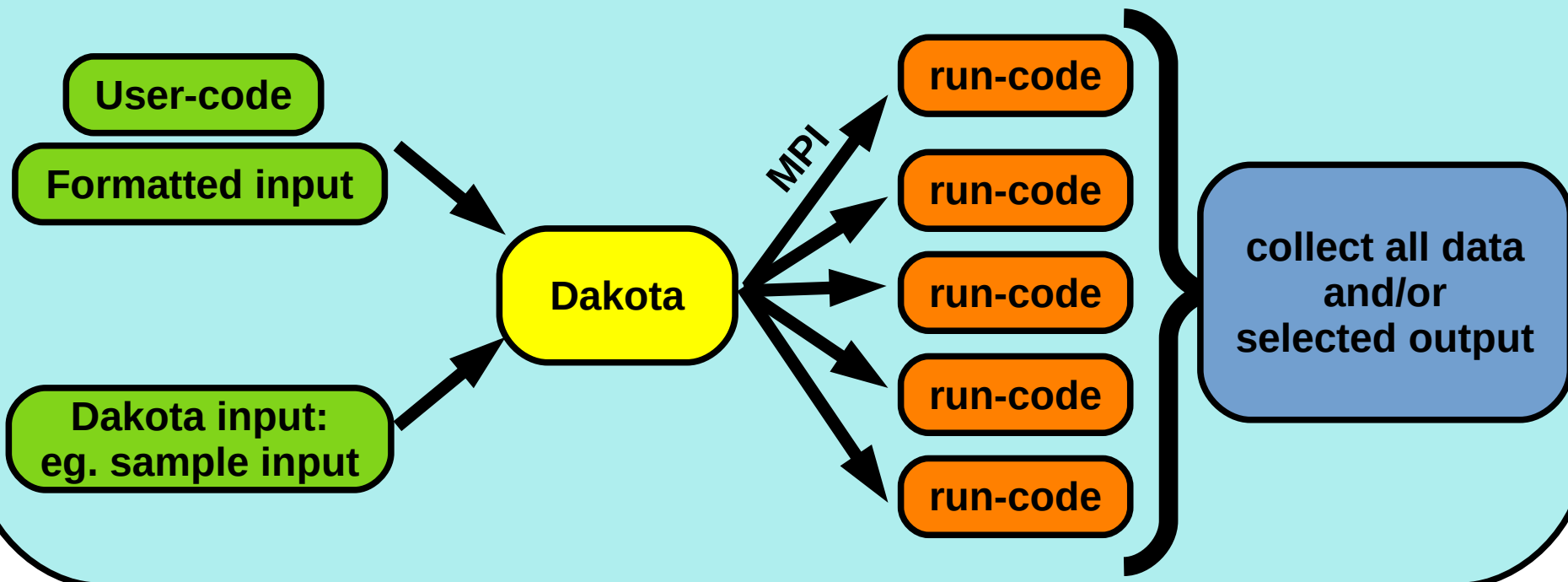
Dakota software for UQ:
<https://dakota.sandia.gov/>



DAKOTA

Explore and predict with confidence.

Computing Cluster



Uncertainty Quantification

Dakota software for UQ:
<https://dakota.sandia.gov/>



DAKOTA
Explore and predict with confidence.

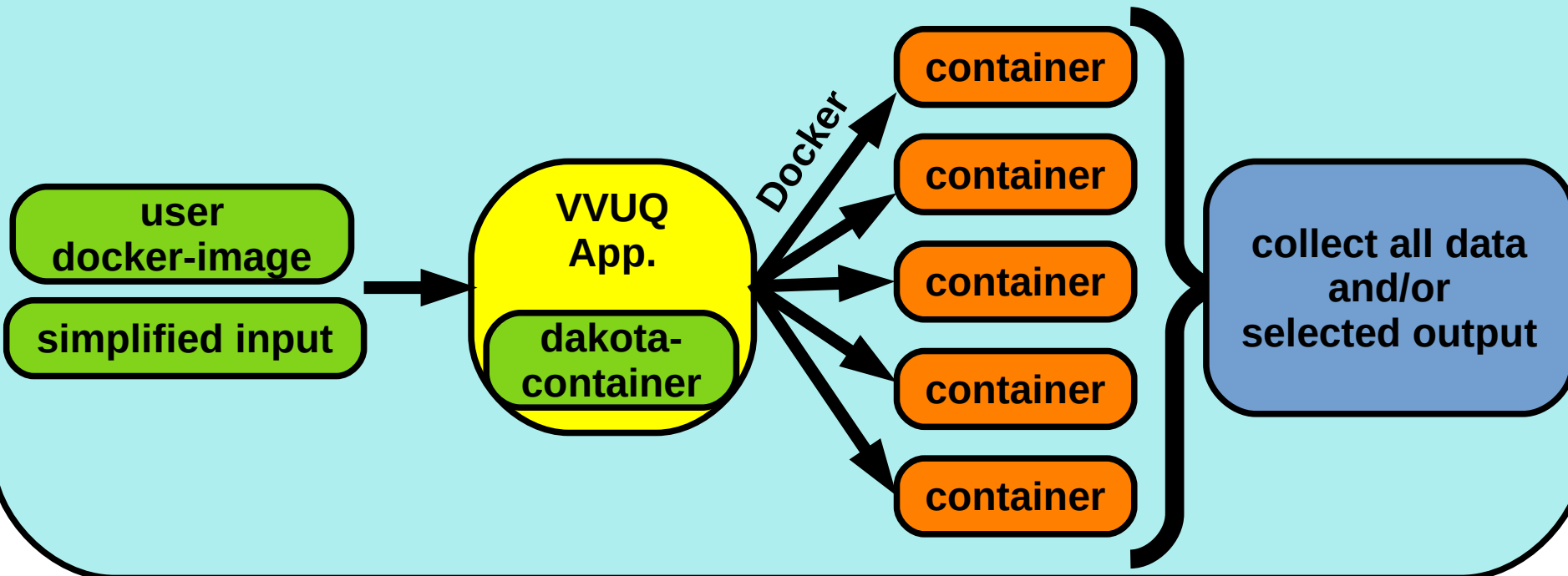
- Pros:**
- large range of UQ methods
(error sampling, input optimization)
 - scalable to large jobs on HPC-clusters
- Cons:**
- heavy learning curve (even for simple sampling)
 - complex input files
 - requires an HPC-cluster for full potential
 - parallelisation only with MPI

VVUQ Apps at CCFE

Two parts:

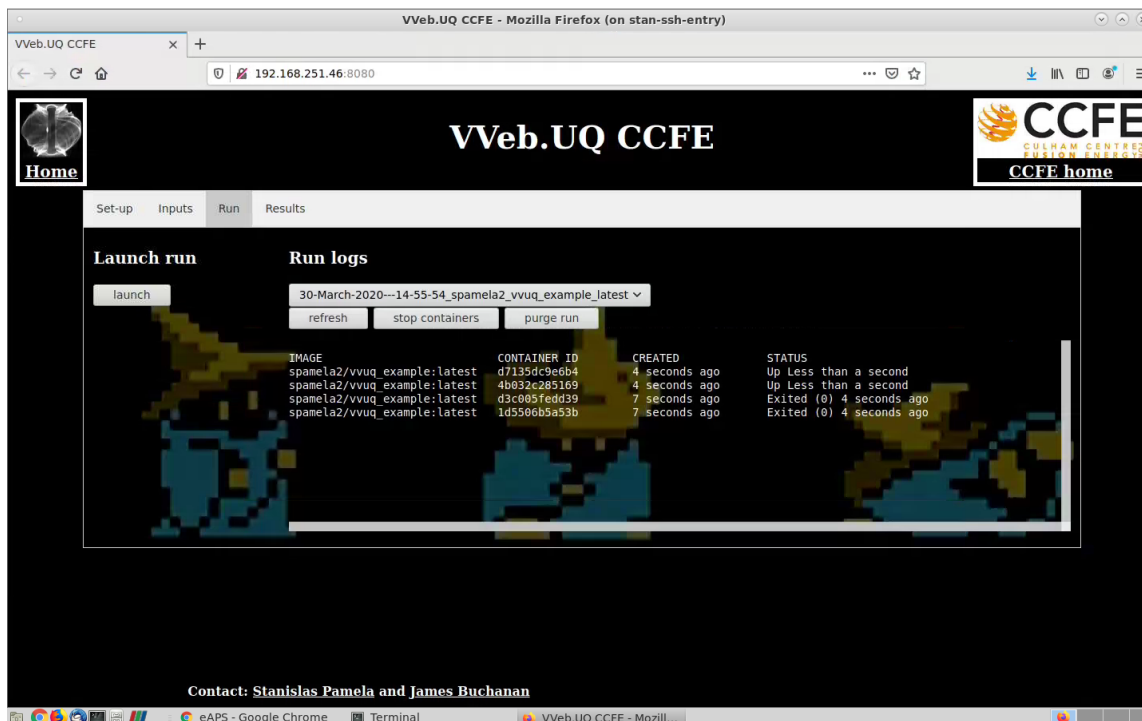
- access-layer around Dakota → simplified user input
- container interface → parallelisation using Cloud-Comp

Cloud Computing Cluster



VVUQ Apps at CCFE

Main app embedded in web interface
(server also launched as container)



Next Developments

Launch on remote Cloud-clusters, with 2 options:

- deploy app (web-server) on a remote cluster → run there
- deploy app locally → send containers to remote clusters
→ use Prominence (A.Lahiff)?

Integrate alternatives to Dakota:

eg. VECMA <https://www.vecma.eu/>

Understand requirements for STEP

Demonstrate application on MAST-U
eg. EFIT, TRANSP

Transp run with Dakota

