



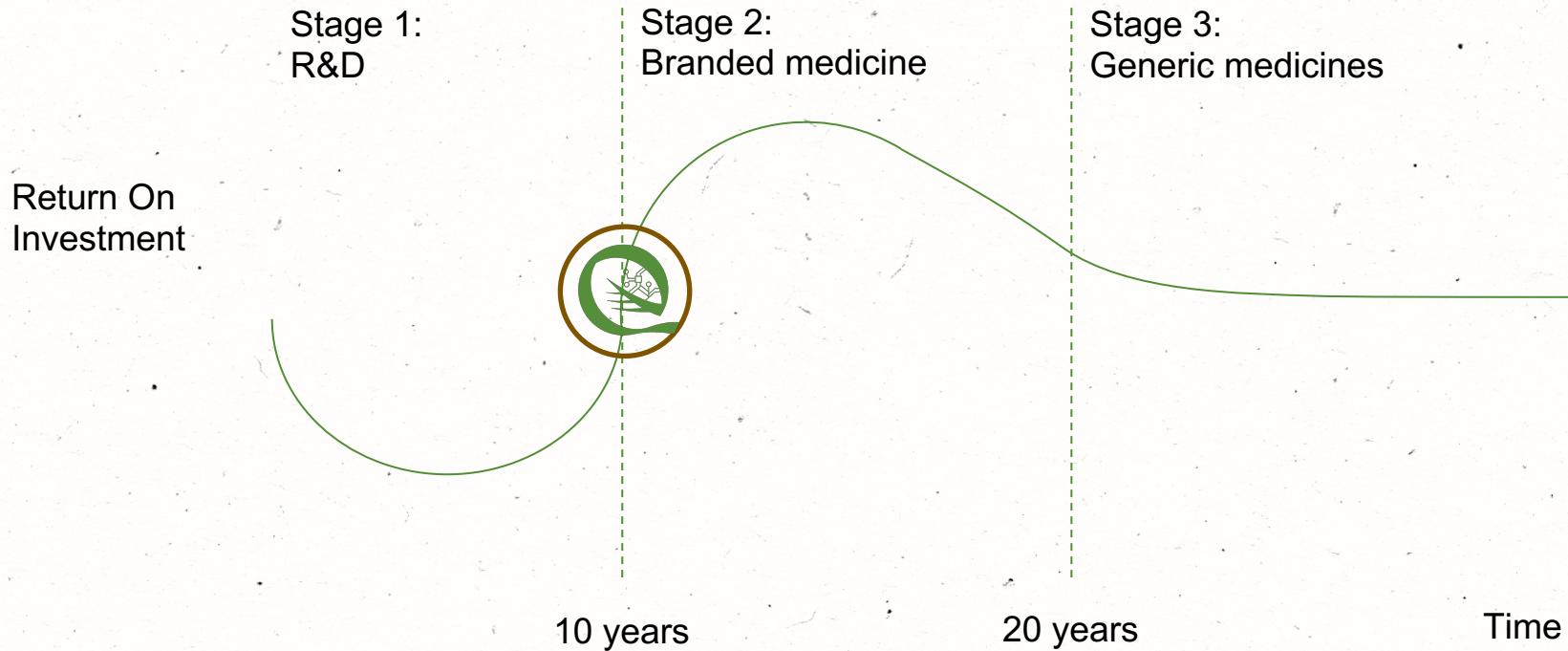
QUEST

QUantum-Enabled SustainabiliTy



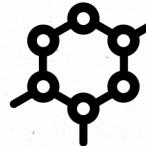
UNTER
NEHMER *PushQuantum*
TUM

THE LIFE OF A DRUG FORMULATION



PROBLEMS WE SOLVE

Dimensions



Profit/Sustainability



Reporting



Quantity



Transparency



Lead-time



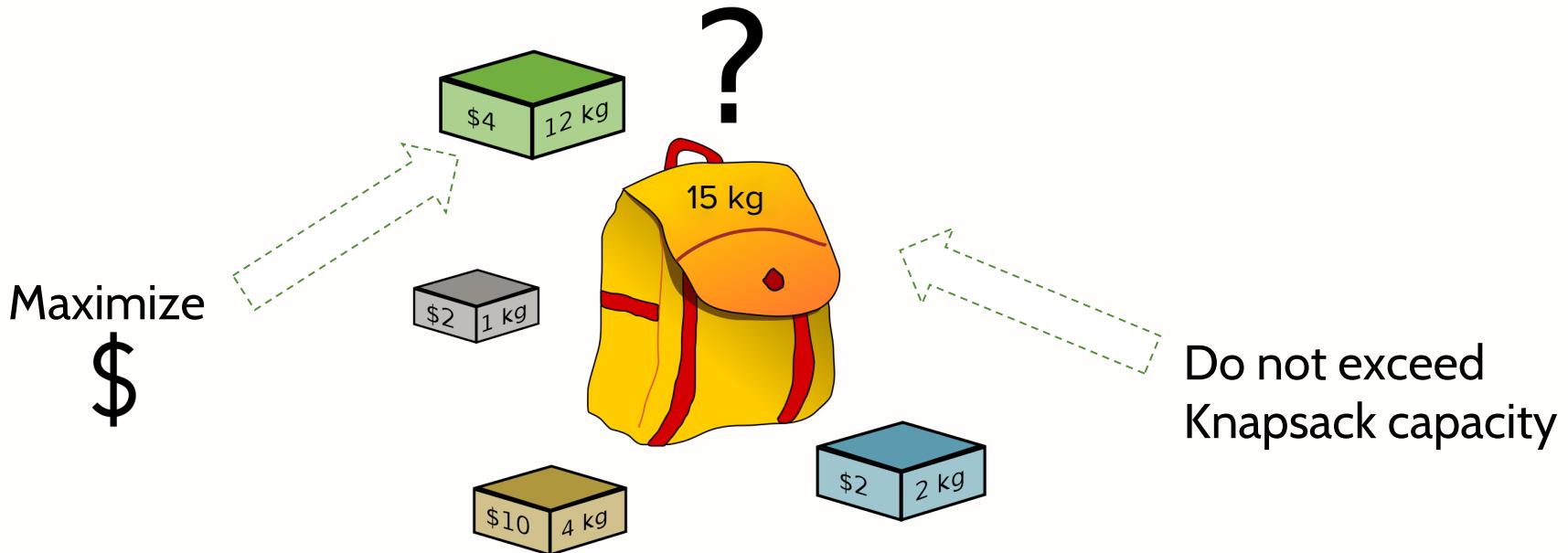
What does Quest do?

Quest is a platform that consolidates and analyzes end-to-end production metrics in the pharmaceutical industry from suppliers and producers to drive sustainability, cost-effectiveness and transparency in product value chain through optimization.

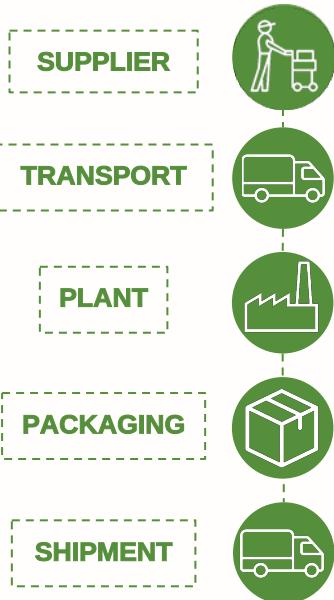
DEMO



OPTIMIZATION USING KNAPSACK



TAYLORING THE KNAPSACK



Click to add text

SUPPLIER 1

S = 80
P = 1M



SUPPLIER 2

S = 99
P = 1.5M



SUPPLIER 3

S = 35
P = 100k

SUPPLIER 4

S = 50
P = 300k

“SHOULDERING” KNAPSACK WITH QUANTUM



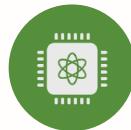
KNAPSACK-TAILORED QAOA

QAOA-Extension allows for Knapsack-specific approach



PROMISING SUCCESS RATE

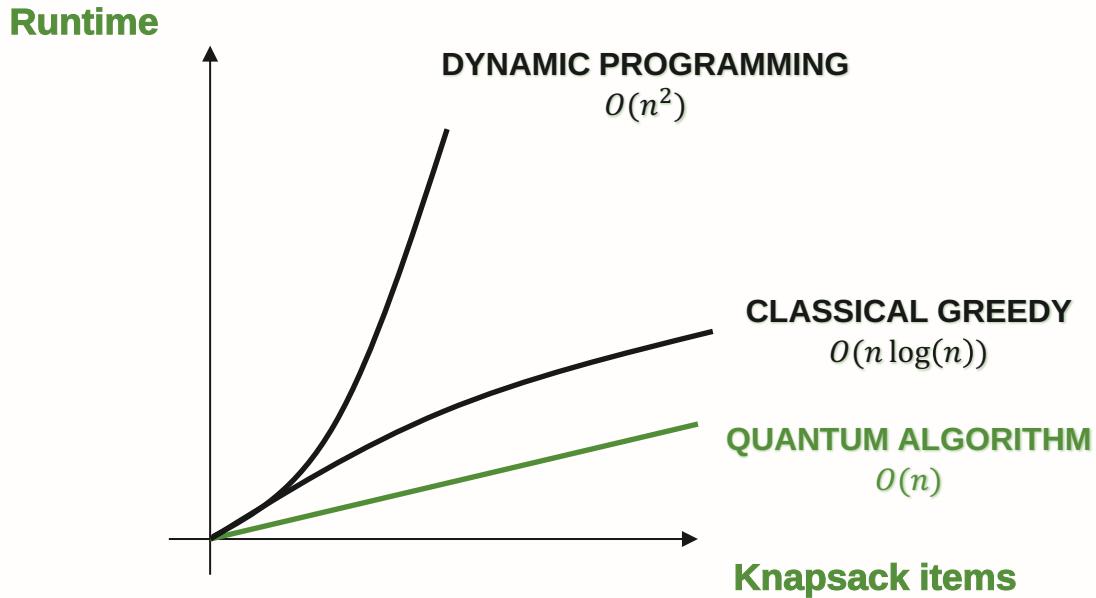
Prototype of algorithm already competes very well



QUANTUM ADVANTAGE

The runtime is linear in the qubit size and uses a constant amount of gates

QUANTUM ALGORITHM IMPROVES SPEED



WHY NOW?



DIGITALIZATION

Digitalization provides data that allow for optimization



CHANGING REGULATIONS

Governments around the world moving toward carbon-neutrality



PRODUCT-LEVEL SUSTAINABILITY

Pharma companies move to product-level for full optimization potential

Carbon dioxide levels in atmosphere reach record high

The
Guardian

Concentrations are 50% above pre-industrial levels despite dip in emissions during Covid pandemic

The last 7 years have been the warmest on record as planet approaches critical threshold



"The pharmaceutical industry emission intensity is about 55% higher than the automotive's."

Carbon footprint of the global pharmaceutical industry and relative impact of its major players

Lotfi Belkhir Ahmed Elmeligi

Climate change: For 25th year in a row, Greenland ice sheet shrinks



United
Nations

UN News

Global perspective Human stories

Jan 11, 2022, 08:00am EST | 1,253 views

ESG Is Here And There's No Turning Back

Forbes

Proposal for a

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

amending Directive 2013/34/EU, Directive 2004/109/EC, Directive 2006/43/EC and Regulation (EU) No 537/2014, as regards corporate sustainability reporting



EUROPEAN COMMISSION

In absolute terms in 2015 the pharmaceutical industry generated 52 million tons of CO₂

“Sustainability is a vital element of our business and a responsibility we want to fulfill every day. Through our innovation power, we strive to create long-term value for society...

— Belén Garijo

Chair of the Executive Board and CEO of Merck



BUSINESS MODEL

ANALYSIS

Offer product-level analysis for products at the end of R&D



VARIABLE COST

Depends on data source validity and customers



TRANSPARENCY

Give an alternative to current ways of procurement



CO-CREATION

Quest platform co-creates value with its partner



60,000,000\$

Pre-production pharmaceutical product - cost per formulation

MARKET ANALYSIS

100 million \$

Serviceable Obtainable Market

~500 million \$

Serviceable Available Market

1200 billion \$

Total Available Market

Pricing Model



Producer



Supplier

Subscription Model

- Volume
- Complexity of supply chain
- Detail of analysis
- Calculation speed



Freemium Model

- No entry cost
- Additional analysis at a cost

WHERE WE ARE

Lookalike prototype
Functional Prototype
Validation of the business case

WHERE WE WANT TO BE

A market place of raw materials in pharmaceutical industry and be the golden standard in production planning



PROJECT TIMELINE

Present our MVP and receive feedback

Pitching

Improve product to user needs

2nd Iteration

Q1
2022

Q1
2023

Q2
2023

Q1
2025

Pilot Project

Pilot project with MERCK with generics

Product Launch

Expansion to related industries

OUR TEAM



**Franz von
Silva-Tarouca**

Quantum
Specialist



**Cristian
Godinez**

Quantum
Specialist



**Benjamin
Classen**

Quantum
Specialist



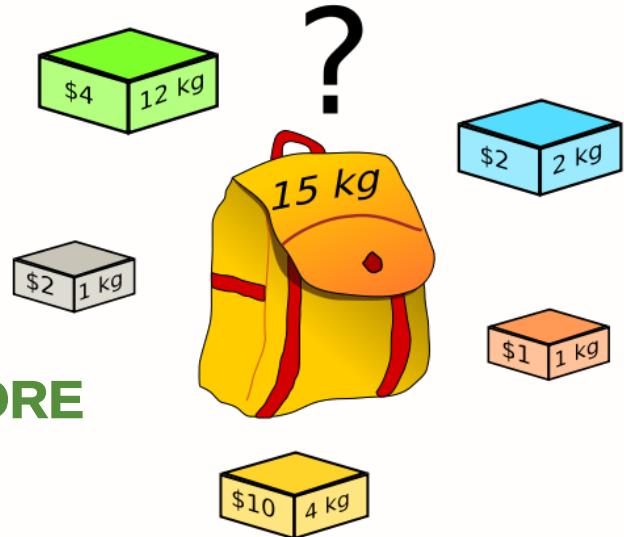
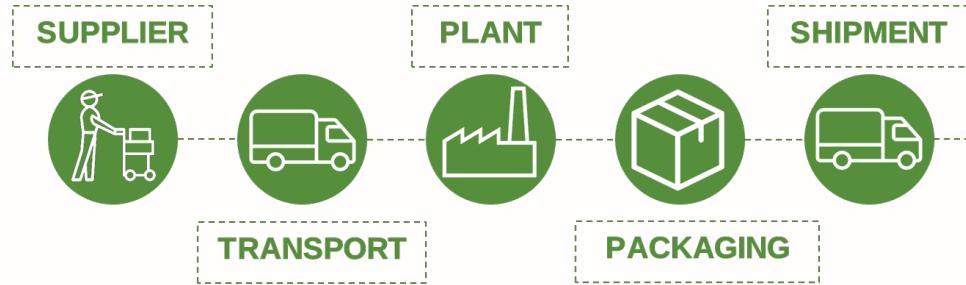
**Yiyun
Tong**

Not a Quantum
Specialist

THANK YOU

Do you have any questions,
comments or feedback?

OPTIMIZATION USING KNASPACK

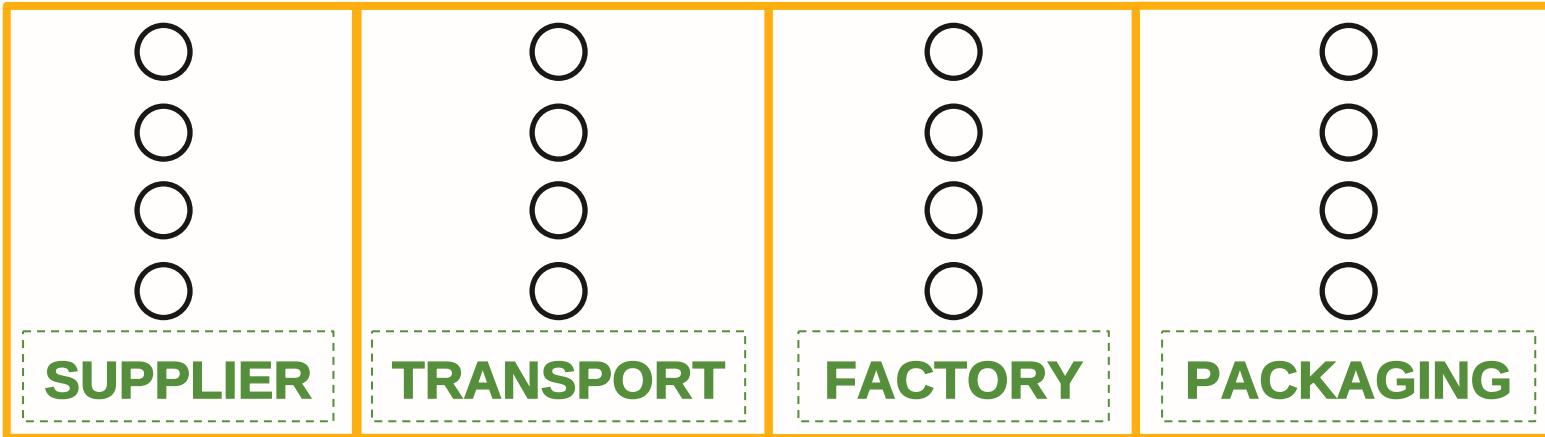


\$
kg

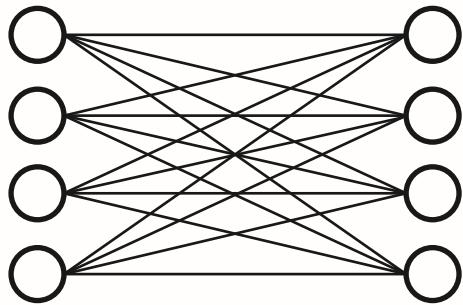
SUSTAINABILITY SCORE

COST SCORE

ALGORITHMIC FORMULATION



ALGORITHMIC FORMULATION



SUPPLIER

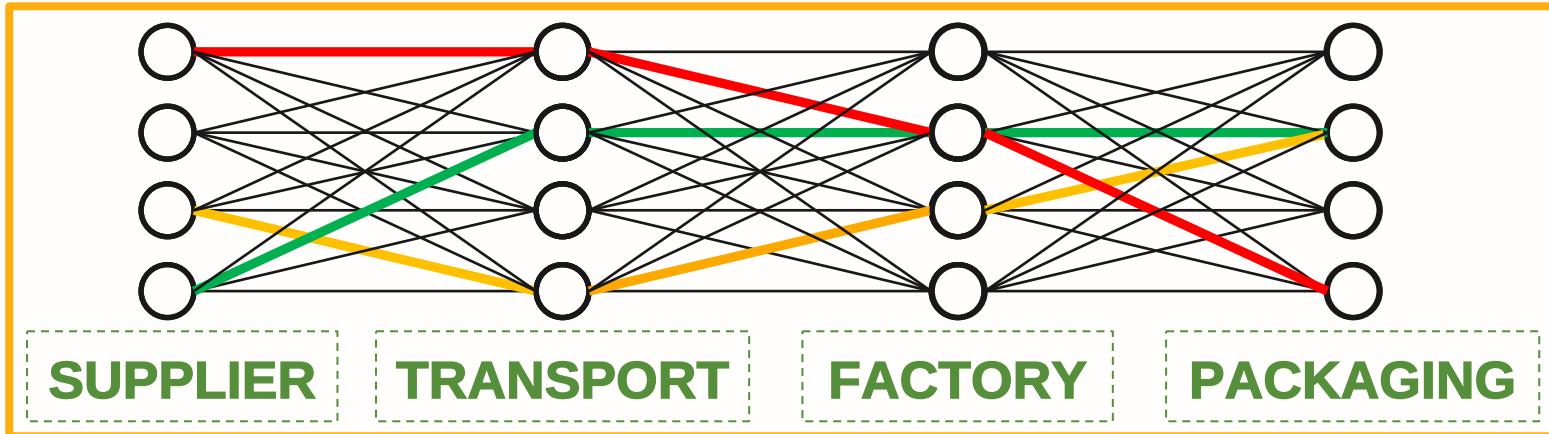
TRANSPORT

FACTORY

PACKAGING



ALGORITHMIC FORMULATION



Back up - PRODUCT FEATURES

SUPPLIER

- Data collection
- Assistance in reporting standards
- Competitor analysis
- PLA analysis
- Supplier onboarding

PRODUCER

- Product development visualization
- Internal PCA application integration
- Procurement analysis
- Production planning
- Optimization of product production ramp-up

Back up slide - 100 million

With current quantum capabilities

Generics: In 2016, 89 percent of all prescriptions dispensed in the U.S. were filled with a generic drug. However, those prescriptions only accounted for 26 percent of total drug costs. Furthermore, generic manufacturers function in a vastly different market from branded companies, where the supply chain captures 64 percent of all revenue on generics, while in the brand market the manufacturers retains 76 percent of revenue

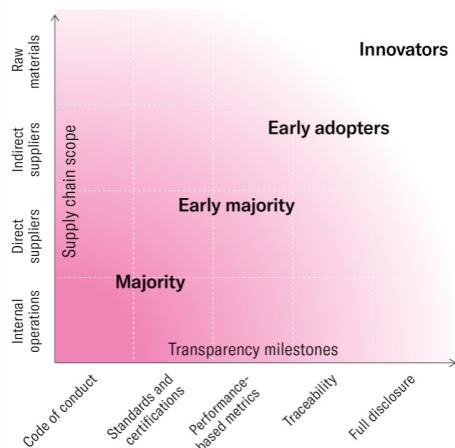
Assume 0.01% improvement that is $0.64 * 1200 \text{ billion} = 7,680,000,000$
If we could optimize for 1% of the generic products out there, it'll be 70 million

Excipients
Packaging

Back up – Benefits to Supplier

How Transparent Is Your Supply Chain?

Transparency can be measured along two dimensions: supply chain scope (the depth of your interaction in the supply chain) and milestones on the path to complete transparency. Most companies are at the majority or early majority stages.



Source: Alexis Bateman and Leonardo Bonanni

© HBR

1. Establish shared goals between the actors along the value chain
2. Establish shared requirements and standards
3. Integrate further development of the model with development of its applications – establish way of working and tools
4. **Create market incentives**
5. Get started! And develop step by step

Pharmaceutical industry transformation is not a matter of if but **when**.

Source: IVL Swedish Environmental Research Institute, 2020

Jun 18, 2010, 11:14am EDT

No Sustainability Without Transparency! **Forbes**

Sustainability doesn't work without transparency



True sustainability needs transparency

The
Guardian

"Sustainability doesn't work without transparency



THE LIFE OF A PILL

SUPPLIER



PLANT



SHIPMENT



TRANSPORT

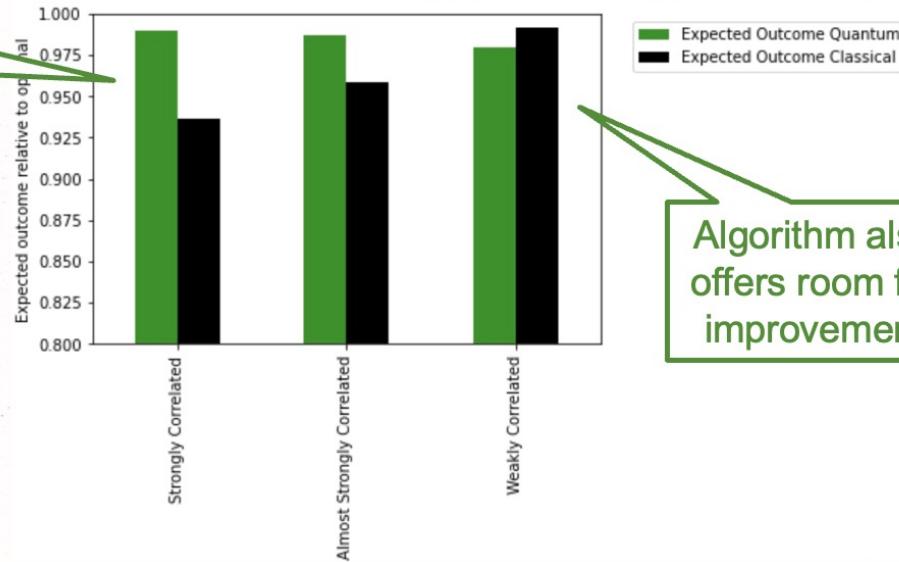


PACKAGING



“SHOULDERING” KNAPSACK WITH QUANTUM

Promising results on hard instances



Algorithm also offers room for improvement