**MRV AAPM 2021 Spring Chapter Meeting SAMs Questions**

 **“AI-based Radiotherapy QA” by Maria F. Chan, PhD, FAAPM**

1. What are the two major types of learning in Machine Learning:
	1. A Transfer learning and statistical learning
	2. Regression and classification
	3. Supervised learning and unsupervised learning
	4. Python and R codes

*Ref: Shai Shalev-Shwartz and Shai Ben-David (Ed). (2014) Understanding machine learning: From theory to algorithms. New York, NY, USA: Publisher Cambridge University Press. ISBN: 978-1-107-05713-5.*

1. Which of the followings is not a machine learning algorithm?
	1. Radom Forest (RF)
	2. Support Vector Machines (SVM)
	3. Convolutional Neural Network (CNN)
	4. Autoregressive moving average (ARMA)
2. Which is not a part in the process of patient-specific QA using machine learning?
	1. Extracting features using scripts to read IMRT beams from TPS database
	2. Building models by calculating all plan complexity metrics affecting passing rate
	3. Collecting IMRT QA data for building and re-training virtual QA models
	4. Measuring treatment machine outputs

*Ref: G Valdes, R Scheuermann, CY Hung, A Olszanski, M Bellerive, TD Solberg, “A mathematical framework for virtual IMRT QA using machine learning”, Medical Physics, 2016; 43(7):4323-4334.* [*doi.org/10.1118/*](https://doi.org/10.1002/acm2.12161)*1.4953835*

1. Which of the following statement on Virtual IMRT QA is not true?
	1. Different TPS dose calculation model needs a different virtual IMRT QA model
	2. Virtual IMRT QA is disease-site dependent
	3. Virtual IMRT QA can accurately predict passing rate for any plan
	4. Virtual IMRT QA model needs to be refined for different detectors and energies

*Ref: G Valdes, MF Chan, SB Lim, R Scheuermann, JO Deasy, and TD Solberg, “IMRT QA using machine learning: A multi-institutional validation”, Journal of Applied Clinical Medical Physics, 2017; 18:5:279-284.* [*doi.org/10.1002/acm2.12161*](https://doi.org/10.1002/acm2.12161)

**“Automation Artificial Intelligence in Medical Physics” by Daniel Johnson, Ph.D.**

1. It is the expectation that artificial intelligence should exhibit the following characteristics…
	1. introversion, intuition, thinking and judgmental
	2. to live, laugh, and love
	3. high velocity, high volume and high variety
	4. intentionality, adaptability and intelligence

*Ref: DM West, JR Allen, How artificial intelligence is transforming the world, Brookings Report, April 24th, 2018*

1. The specialized metrics for the evaluation of unbalanced data sets used in machine learning applications are…
	1. Precision and Recall (F-measure)
	2. Ad Hoc and post hoc ergo propter hoc
	3. Sensitivity and Specificity
	4. Supervised Testing and Unsupervised Examination

*Ref: Powers, David M W, Evaluation: From Precision, Recall and F-Measure to ROC, Informedness, Markedness & Correlation, Journal of Machine Learning Technologies. 2 (1): 37–63*

1. In an example of computer aided diagnosis, aspects of analysis previously performed by radiomics applications was replaced by a deep learning method that utilized…
	1. GANs
	2. CNNs
	3. Decision Trees
	4. MSNBCs

*Ref: Huynh B.Q., Li H., M.L. Giger, Digital mammographic tumor classification using transfer learning from deep convolutional neural networks, J. Med. Imaging, 3 (2016), p. 034501*

 **“Practical implementation of EPID-based QA for LINAC” by Baozhou Sun, Ph.D.**

1. The EPID can be used to check the following QA tests:

A. Dosimetry output constancy

B. Beam flatness and symmetry

C. Winston Luts test

D. MLC positioning accuracy

E. All of above

*Ref: Sun, Baozhou, S. Murty Goddu, Sridhar Yaddanapudi, Camille Noel, Hua Li, Bin Cai, James Kavanaugh, and Sasa Mutic. "Daily QA of linear accelerators using only EPID and OBI." Medical physics 42, no. 10 (2015): 5584-5594.*

*Ref: Rowshanfarzad, P., Sabet, M., O'Connor, D. J., & Greer, P. B. (2011). Verification of the linac isocenter for stereotactic radiosurgery using cine‐EPID imaging and arc delivery. Medical physics, 38(7), 3963-3970.*

2. What are the advantages of using EPID for machine QA:

A. High Resolution

B. Digital output for automation

C. No dose rate dependence

D. Linear dose response

E. All of above

F. A, B, D

*Ref: Winkler, Peter, Alfred Hefner, and Dietmar Georg. "Dose‐response characteristics of an amorphous silicon EPID." Medical physics 32.10 (2005): 3095-3105*

*Ref: Greer PB, Popescu CC, Dosimetric properties of an amorphous silicon electronic portal imaging device for verification of dynamic intensity modulated radiation therapy. Med Phys 31(2004\_: 285–295.*

3. Compared with the old EPID panel as1000, what are the advantages of new EPID panel aS1200?

A. It can used be used for flattern field free beams with high dose rate

B. It reduced the backscatter of the support arm

C. It has a large field size and higher resolution

D. All of above

*Ref: Xu Z, Kim J, Han J, Hsia AT, Ryu S. Dose rate response of Digital Megavolt Imager detector for flattening filter-free beams. J Appl Clin Med Phys. 2018;19(4):141–147. doi:10.1002/acm2.12358*

*Ref: Miri N, Keller P, Zwan BJ, Greer P. EPID-based dosimetry to verify IMRT planar dose distribution for the aS1200 EPID and FFF beams. J Appl Clin Med Phys. 2016;17(6):292–304. Published 2016 Nov 8. doi:10.1120/jacmp.v17i6.6336*

**“Automation in Planning and Delivery of Stereotactic Radiosurgery” by Richard Popple, Ph.D.**

1. The most effective method of minimizing dose to normal brain for single isocenter VMAT radiosurgery is

1. Choosing the collimator angles to minimize MLC leaf sharing
2. Choosing the table angles to minimize MLC leaf sharing
3. Using jaw tracking
4. Including a constraint on the normal brain dose in the optimization objective function
5. Turning off the display of the normal brain DVH

*Ref: Yuan Y, Thomas EM, Clark GA, Markert JM, Fiveash JB, Popple RA. Evaluation of multiple factors affecting normal brain dose in single-isocenter multiple target radiosurgery. J Radiosurg SBRT. 2018;5(2):131-144. PMID: 29657894; PMCID: PMC5893454.*

2. Compared to human-generated treatment plans, SRS treatment plans created by a knowledge-based machine-learning system were preferred by the physician

1. < 10% of the time
2. 25% of the time
3. 50% of the time
4. 75% of the time
5. > 90% of the time

*Ref: Ziemer BP et al. Fully automated, comprehensive knowledge-based planning for stereotactic radiosurgery: Preclinical validation through blinded physician review. Practical Radiation Oncology (2017) 7, e569-e578.*

3. Compared to manual VMAT and Gamma Knife, the automated planning systems HyperArc and Multi-Metastasis Elements had

1. The least patient-specific QA effort
2. The best delivery efficiency
3. The least inter-planner variability
4. The best conformity index
5. The best dose falloff

*Ref: Vergalasova I, et al. (2019) Multi-Institutional Dosimetric Evaluation of Modern Day Stereotactic Radiosurgery (SRS) Treatment Options for Multiple Brain Metastases. Front. Oncol. 9:483. doi: 10.3389/fonc.2019.00483.*

**“Data-Driven Control on Multi-Institutional Clinical Trials” by Jessica Lowenstein, M.S.**

1. The purpose of using KBP in multi-institutional trials is to:
2. Drive physicist and dosimetrists crazy
3. Attempt to limit the number of trial participants treated with suboptimal treatment plans
4. A & B
5. None of the above

*Ref: Quantifying Unnecessary Normal Tissue Complication Risks due to Suboptimal Planning: A Secondary Study of RTOG 0126; Kevin Moore et al; Int J of Radiation Oncol Biol Phys, Vol 92, No. 2,pp. 228-235, 2015*

1. Even though the planning target volume (PTV) meets the protocol guidelines, it is possible to utilize the KBP to improve the sparing of organs-at-risk (OAR):
2. True
3. False

*Ref: Tol JP, et al., Analysis of EORTC-1219-DAHANCA-29 trial plans demonstrates the potential of knowledge-based planning to provide patient-specific treatment plan quality assurance. Radiother Oncol 130, pp75-81, 2019.*

1. The NRG-HN001 site-specific KBP model showed that:
2. The dose received by 95% of the PTV is similar between the submitted and KBP plans.
3. A relative improvement of at least 5% can be achieved in the maximum dose to the OAR.
4. A & B
5. None of the above

*Ref: Giaddui, T, et al., Offline Quality Assurance fir Intensity Modulated Radiation Therapy Treatment Plans for NRG-HN001 Head and Neck Clinical Trial Using Knowledge-Based Planning. Adv. Radiat. Oncol.2020 May 22:5(6):1342-1349.*

**“Knowledge-Based Planning: Applying Lessons of the Past to Improve Radiotherapy Treatments” by Kenny Guida, DMP**

1. Which statistical tools would be helpful in detecting Geometrical Outliers?
2. Regression Plots
3. In-Field DVH
4. Modified Z-Score (mZ)
5. All the Above
6. A and C only
7. What aspects of treatment planning knowledge can be included in a specific model?
8. OAR DVH data
9. Multiple PTV Prescriptions
10. Multiple OAR Structures
11. Beam/Arc Angles
12. All the Above
13. You’ve deduced that a certain plan in your model is a Dosimetric Outlier. Which options are available to you?
14. Replan and see if the new plan improves model
15. Remove the outlier plan/structure
16. Leave it in
17. All the Above