**4/11 QUIZ NR 9** **Math118, O.Knill**

Name:

1) Which of the following properties apply to the Baker transformation $T$ on the square $[0,1) \times [0,1)$.

a) The map is continuous.
b) There is a conjugation of the map to a subshift $S(Y) \subset \{0,1\}^Z$
c) There is a conjugation of the map to the shift $S(Y) \subset \{0,1\}^N$
d) The map is area-preserving.
e) The map has many periodic points.
f) The map has no periodic points.
g) The map is invertible.

2) True or False: If you take a subshift $X$ of finite type, and a cellular automaton $\phi$, then $\phi(X)$ is a subshift of finite type.

3) True or False: If you take a sophic subshift and a cellular automaton $\phi$, then $\phi(X)$ is a sophic subshift.

4) Which of the following inclusions are true? (I had this once wrong on the blackboard and Orr had corrected it):

a) subshifts $\supset$ subshifts of finite type $\supset$ sophic subshifts.

b) subshifts $\supset$ sophic subshifts $\supset$ subshifts of finite type.

5) True or False: the **language** of a subshift of finite type is the set of forbidden words.

6) What can you say about the subshift $X$ of finite type over the alphabet $\{a,b,c\}$ defined by the forbidden words $\{aa, bb, cc, ac, ba, cb\}$?

a) $X$ does not contain any point.
b) $X$ contains only finitely many points.
c) $X$ contains infinitely many points.

7) Which of the following subshifts is the shift over the alphabet $\{a,b\}$ for which all words $bab, baaab, baaaaab, baaaaaaab, baaaaaaaaaab, ...$ etc. are forbidden?

a) The Fibonacci shift
b) The even shift
c) The golden mean shift
d) The full shift.

8) When doing symbolic dynamics for the Arnold cat map $T(x,y) = (2x+y, x+y)$ mod 1, one uses a subshift of finite type over an alphabet with a minimal amount of letters. This alphabet has

a) 2 elements.
b) 3 elements.
c) 5 elements.
d) 6 elements.

9) Two random variables $Y$ and $Z$ taking finitely many values are called **uncorrelated** if

a) $P[Y=a, Z=b] = P[Y=a]P[Z=b]$ for all possible numbers $a, b$.

b) $E[YZ] = E[Y]E[Z]$.

10) Assume, a sequence of independent identically distributed random variables $Y_1, Y_2, Y_3, ...$ describes drawing a card from an infinite deck containing 52 types of cards. It is assumed that each card appears with the same probability 1/52 and that a card can appear multiple times. How do you model these random variables?

a) $Y_k(y) = y_k$, where $y \in \{1, ..., 52\}^N$.

b) $Y_k(y) = k$, where $y \in \{1, ...., 52\}^N$.

c) $Y_k(y) = y$, where $y \in \{1, ..., 52\}^N$.