DNA Analysis

February 21, 2024

Revised September 18, 2024
Revised December 13, 2024

Optimal Bit Assignments

Adenine (A) = (00) Cytosine (C) = (10)

Guanine (G) = (01) Uracil (U) = (11)

Wobble Base Pairing Code

Anticodon	DNA Code	AminoAcid	Codon	Binary Code	Optimal Assignment of Minterms	Logic Equations
CGG	GCU GCC	Alanine (Ala)	GCA GCG GCC GCU	011000 011001 011010 011011	m24 (J'KLM'N'O') m25 (J'KLM'N'O) m26 (J'KLM'NO) m27 (J'KLM'NO)	m24+m25+m26+m27 = LM'J'K=J'KLM'
CGU	GCA GCG					
GCG	CGU CGC	Arginine (Arg)	AGA AGG CGA CGG CGC CGU	000100 000101 100100 100101 100110 100111	m4 (J'K'L'MN'O') m5 (JK'L'MN'O') m36 (JK'L'MN'O') m37 (JK'L'MN'O) m38 (JK'LMNO') m39 (JK'L'MNO)	m4+m5+m36+m37+m38+m39 = (J'N)'K'L'M
GCU	CGA CGG					
UCU	AGA AGG					
UUG	AAU AAC	Asparagine (Asn)	AAC AAU	000010 000011	m2 (J'K'L'M'NO') m3 (J'K'L'M'NO)	m2+m3+ = L'M'NJ'K'= J'K'L'M'N
CUG	GAU GAC	Aspartic Acid (Asp)	GAC GAU	010010 010011	m18 (J'KL'M'NO') m19 (J'KL'M'NO')	m18+m19=J'KL'M'N
ACG	UGU UGC	Cysteine (Cys)	UGC UGU	110110 110111	m54 (JKL'MNO') m55 (JKL'MNO)	M54+M55=NL'MJK = JKL'MN
CCG	GGU GGC	Glycine (Gly)	GGA GGG GGC GGU	010100 010101 010110 010111	m20 (J'KL'MN'O') m21 (J'KL'MN'O) m22 (J'KL'MNO') m23 (J'KL'MNO)	m20+m21+m22+m23 = J'KL'M
CCU	GGA GGG					
GUU	CAA CAG	Glutamine (Gln)	CAA CAG	100000 100001	m32 (JK'L'M'N'O') m33 (JK'L'M'N'O)	m32+m33=JK'L'M'N'
CUU	GAA GAG	Glutamic Acid (Glu)	GAA GAG	010000 100001	m16 (J'KL'M'N'O) m17 (JK'L'M'N'O)	m16+m17=J'KL'M'N'
GUG	CAU CAC	Histidine (His)	CAC CAU	100010 100011	m34 (JK'L'M'NO') m35 (JK'L'M'NO)	m34+m35=L'M'NJK' = JK'L'M'N
UAG UAU	AUU AUC AUA	Isoleucine (Ile) (Met) AUG	AUA AUC AUU	001100 001110 001111	m12 (J'K'LMN'O') m14 (J'K'LMNO') m15 (J'K'LMNO)	m12+m14+m15= J'K'LM(N'O)'
AAU GAG GAU	UUA UUG CUU CUC CUA CUG	Leucine (Leu)	CUA CUG CUC CUU UUA UUG	101100 101101 101110 101111 111100 111101	m44 (JK'LMN'O') m45 (JK'LMN'O) m46 (JK'LMNO') m47 (JK'LMNO) m60 (JKLMN'O') m61 (JKLMN'O)	m44+m45+m46+m47+m60+m61= (KN)'JLM = J(KN)'LM

Optimal Bit Assignments

Adenine (A) = (00) Cytosine (C) = (10)
Guanine (G) = (01) Uracil (U) = (11)

Wobble Base Pairing Code

Anticodon	DNA Code	AminoAcid	Codon	Binary Code	Optimal Assignment of Minterms	Logic Equations
UUU	AAA AAG	Lysine (Lys)	AAA AAG	000000 000001	m0 (J'K'L'M'N'O') m1 (J'K'L'M'N'O)	m0+m1 = J'K'L'M'N'
UAC	AUG (Start Codon)	Methionine (Met)	AUG	001101	m13 (J'K'LMN'O)	m13 = J'K'LMN'O
AAG	UUU UUC	Phenylalanine (Phe)	UUC UUU	111110 111111	m62 (JKLMNO') m63 (JKLMNO)	m62+m63 = KNJLM = JKLMN
GGG	CCU CCC	Proline (Pro)	CCA CCG CCC CCU	101000 101001 101010 101011	m40 (JK'LM'N'O') m41 (JK'LM'N'O) m42 (JK'LM'NO') m43 (JK'LM'NO)	m40+m41+m42+m43 = LM'JK' = JK'LM'
GGU	CCA CCG					
UCG	AGU AGC	Serine (Ser)	AGC AGU UCA UCG UCC UCU	000110 000111 111000 111001 111010 111011	m6 (J'K'L'MNO') m7 (J'K'L'MNO) m56 (JKLMN'O') m57 (JKLM'N'O) m58 (JKLM'NO') m59 (JKLM'NO)	m6+m7+m56+m57+m58+m59 = (LM'JK) + J'NK'L'M = JKLM' + J'K'L'MN
AGG	UCU UCC					
AGU	UCA UCG					
UGG	ACU ACC	Threonine (Thr)	ACA ACG ACC ACU	001000 001001 001010 001011	m8 (J'K'LM'N'O') m9 (J'K'LM'N'O) m10 (J'K'LM'NO') m11 (J'K'LM'NO)	m8+m9+m10+m11 = J'K'LM'
UGU	ACA ACG					
ACC	UGG	Trptophan (Trp)	UGG	110101	m53 (JKL'MN'O)	m53 = JKL'MN'O
AUG	UAU UAC	Tyrosine (Tyr)	UAC UAU	110010 110011	m50 (JKL'M'NO') m51 (JKL'M'NO)	m50+m51 = L'M'NJK = JKL'M'N
CAG	GUU GUC	Valine (Val)	GUA GUG GUC GUU	011100 011101 011110 011111	m28 (J'KLMN'O') m29 (J'KLMN'O) m30 (J'KLMNO') m31 (J'KLMNO)	m28+m29+m30+m32 = J'KLM
CAU	GUA GUG					
AUU	UAA UAG	Stop/Term	UAA UAG UGA	110000 110001 110100	m48 (JKL'M'N'O') m49 (JKL'M'N'O) m52 (JKL'MN'O')	m48+m49+m52 = L'N'JK(M'+O') = JKL'N' (M'+O')
ACU	UGA					
3rd Base in Anticodon Wobble Code G ↔ U or C C ↔ G A ↔ U U ↔ A or G	3rd Base in Codon	Anticodon/Codon G ↔ C A ↔ U				

Optimal Bit Assignments

Universal DNA Code

DNA Code Using Uracil (U)
(AGCU)

Adenine (A) = (00) Cytosine (C) = (10)
Guanine (G) = (01) Uracil (U) = (11)

Wobble Base Pairing Code

Anticodon/Codon	AminoAcid	Code	Logic Equations
CGU/GCA-GCG	Alanine (Ala)	011000 011001	J'KLM'
GCG/CGC-CGU UCU/AGA-AGG	Arginine (Arg)	100110 100111 000100 000101	(J'N)'K'L'M
UUG/AAC-AAU	Asparagine (Asn)	000010 000011	J'K'L'M'N
CUG/GAC-GAU	Aspartic Acid (Asn)	010010 010011	J'KL'M'N
ACG/UGC-UGU	Cysteine (Cys)	110110 110111	JKL'MN
CCU/GGA-GGG	Glycine (Gly)	010100 010101	J'KL'M
GUU/CAA-CAG	Glutamine (Gln)	100000 100001	JK'L'M'N'
CUU/GAA-GAG	Glutamic Acid (Glu)	010000 010001	J'KL'M'N'
GUG/CAC-CAU	Histidine (His)	100010 100011	JK'L'M'N
UAG/AUC-AUU	Isoleucine (Ile)	001110 001111	J'K'LM(N'O)'
GAU/CUA-CUG AAU/UUA-UUG	Leucine (Leu)	101100 101101 111100 111101	J(KN)'LM

Optimal Bit Assignments

Universal DNA Code

Adenine (A) = (00) Cytosine (C) = (10)
Guanine (G) = (01) Uracil (U) = (11)

DNA Code Using Uracil (U)
(AGCU)

Wobble Base Pairing Code

Anticodon/Codon	AminoAcid	Code	Logic Equations
UUU/AAA-AAG	Lysine (Lys)	000000 000001	J'K'L'M'N'
UAC/AUG Start Condon	Methionine (Met)	001101	J'K'LMN'O
AAG/UUC-UUU	Phenylalanine (Phe)	111110 111111	JKLMN
GGU/CCA-CCG	Proline (Pro)	101000 101001	JK'LM'
UCG/AGC-AGU AGU/UCA-UCG	Serine (Ser)	000110 000111 111000 111001	JKLM' + J'K'L'MN
UGU/ACA-ACG	Threonine (Thr)	001000 001001	J'K'LM'
ACC/UGG	Tryptophan (Trp)	110101	JKL'MN'O
AUG/UAC-UAU	Tyrosine (Tyr)	110010 110011	JKL'M'N
CAG/GUC-GUU	Valine (Val)	011110 011111	J'KLM
AUU/UAA-UAG ACU/UGA	Stop/Term	110000 110001 110100	JKL'N' (M'+O')

Wobble Code

5' Base in Anticodon	3' Base in Codon
G	U or C
C	G
A	U
U	A or G

RNA LOGIC

Network and Synthesis

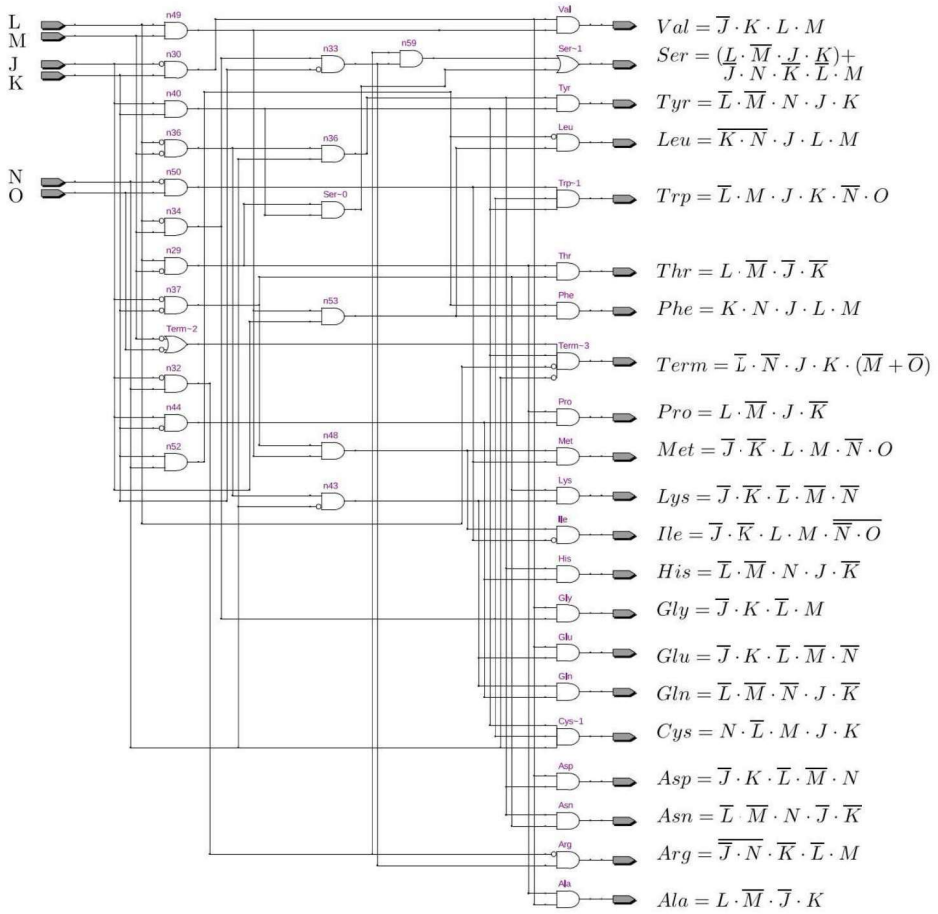

Figure 1: Gate Schematic generated by Quartus for amino acid functions constructing the Universal Code using AGCU = 00011011 assignment.

2 – Bit DNA Decoder